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A reservoir of old aqueduct pipe

Why the concrete reservoir does not find great favor

Cutting Power Bills on the Irrigated Farm

OUT in California, where crops are produced by irrigation, a vast and intricate network of heavily charged electric wires covers tens of thousands of acres of fine farm lands, radiating from a hundred mountain power houses, to furnish power for pumping plants, house lighting, and the various machines. Two kinds of contracts are made by the companies that sell this power. The rate to the man who agrees to use the current continuously is about half that charged the consumer who insists upon having the power that he wants when he wants it, which is usually when everybody else wants it, and letting the load on the transmission lines drop to next to nothing during the hours when he is not actually pumping.

This of course is necessary to enable the companies to meet peak-load conditions successfully. The wise farmer accordingly seeks how he may so lay out his plant as to take advantage of the lower rate afforded him by continuous running. To reduce the size of his pumping plant and to provide some place for storing the water pumped during the hours when it is not actually distributed to his fields is what his problem reduces to. He must pump at a slower rate in order to extend his pumping over the entire twenty-four hours, and he must have a storage place where he can put the water when he is not using it on his crops.

Thus, a farmer having a 60-horse-power plant pumping 100 inches during 12 hours can, by installing a plant with a capacity for only 50 inches and keeping this going continuously night and day, storing in a reservoir the water pumped at night, have the same quantity of water to work with during the day as he had with the larger plant. The first cost of the smaller plant is a great deal less than that of the larger one. The new power rate is but half the old, and the amount of current used is practically the same. The only additional item of expense is the construction of a storage reservoir.

The concrete reservoir has been abandoned as a failure by most farmers of the state. Local talent cannot build one that will not crack and settle under the full load of water, and even those put up by experts give trouble in this way. But it costs the farmer little, using his own teams and implements, to scrape up four banks of earth to form a rectangular basin on the highest point of his farm; and with a coating of crude oil to make the inside surface watertight, he has a serviceable and non-breakable reservoir.

In heavy loam soil the earth reservoir is constructed most cheaply. After the banks have been thrown up, crude oil is sprinkled from cans over the interior surface. One man throws the oil on from the top of the bank, while another heaps shovels of loose earth over it. A piece of old well-casing is convenient to roll the banks. In the same way oil is sprinkled over the floor of the reservoir. The sprinklers are made by the simple expedient of perforating the bottom of a five-gallon oil can with nail holes; if desired, they can be used suspended on a bar carried by two men.

A fine reservoir location among the boulders on a hillside

The oil serves more than one purpose. Besides making the soil watertight, it discourages tunneling of rabbits, squirrels, gophers and rats, prevents the growth of water plants, and keeps the interior of the reservoir clean at all times. To make the outside banks firm and solid a light dressing of oil may also be applied; and this prevents the earth from being washed away by rains.

Oiling the sides of a home-made reservoir

A reservoir of this type, 62x175 feet, was built by three men in a week. Twenty-five hundred gallons of oil at three cents a gallon were used. The entire cost was $200. From this pond 250 acres of alfalfa land are irrigated. The benefit to the owner in reduced power rates is about $400 a year, so it seems as though this reservoir may have paid for itself. The figures given present quite a contrast with the savings shown by large corporate undertakings, where all that is asked of a betterment is that it pay interest and sinking-fund charges on its original cost.

Perhaps the most inexpensive reservoirs yet built in the pursuit of the low power rate were those put in by a farmer who is located on a gently sloping plain. Selecting places where this slope was indented by the small draws in which the rain water runs off, he proceeded to erect dams at the lower border of his property and in this manner impounded water at several places, covering areas of 2, 5 and 10 acres, respectively. Before putting these ponds into operation he ran a little water over their prospective bottoms; and after the heavy loam soil had absorbed this sufficiently he drove a herd of cattle into the sites. These trampled the damp floors until they held water well, and the amount of seepage from the reservoirs thus formed is trivial. The owner spent $50 in building the smallest of these lakes, and $100 for the largest.

But a rancher at Lordsburg has beaten this for ingenuity. A large quantity of condemned, 60-inch diameter concrete piping, originally intended for use in the construction of the Los Angeles Aqueduct, was sold recently for practical y nothing to persons who would remove the piping from the supply yards. The man in question secured a quantity of this and constructed his reservoir of it. Sections of the condemned piping were cemented together to form several long tubes or cylinders. The open ends of these were closed by cement walls. Manholes as vents and for cleaning purposes were cut at several points along the top of the tanks and pipes controlled by valves for drainage were inserted at each end.

When the farmer has finally made himself eligible for the minimum rate offered by the power company, he knows at the beginning of the season just what his irrigation will cost him. When the rains come, he can fill his reservoirs without pumping, and use his motor to operate a cream separator, a saw, a thresher, etc. He can even afford to shut down his plant for a third of the year or more, paying for the current he was entitled to use but did not, and still find his annual power bill less than under the old rates.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Freedom of the Seas

AT about the time when Germany first realized that the Allied blockade must sooner or later beget such a shortage of raw materials as to make it impossible for her to continue the war, she dug up from the ancient records of maritime history the phrase "freedom of the seas," and included it among the many specious catchwords and formulas which she was accustomed to sprinkle throughout her written and spoken propaganda.

The freedom of the seas is the most fair and seemly child in a litter which includes many another offspring of German cunning; and she brought it forth, or rather gave it re-birth, in the very hour when she was planning to establish upon the seas with her U-boats a reign of tyranny and murder, which should make the ferocities of a Morgan or Captain Kidd shrink into insignificance.

Mare clausum (closed sea) and *mare liberum* (free sea) are terms which were used several centuries ago in a controversy that arose out of the claim, made by various states, that they had the right to exclusive dominion over extensive areas of the high sea. Grotius wrote a work in 1609 entitled "Free Sea," and to Brynkershock we are indebted for a book, *De dominio maris* (Concerning the control of the sea), published in 1702, in which he laid down the principle, that a maritime state should have dominion over the sea only as far as a cannon shot could protect it. That was three miles. The formula was accepted, and upon it has been established that three-mile strip along the coastline known as Territorial Water, of which we heard so much during the recent war.

Now, when Germany realized that the right of blockade, universally recognized, was destined to bring her to her knees by depriving her of materials for her armies, she sought to confuse the issue by disinterring the long-buried question of *mare liberum*, or free sea, and hoisting it as a protest against the British blockade. But in this subterfuge she fooled no one, and least of all the United States. For as soon as we entered the war, we screwed down the clamps of the blockade tighter than before, even to the extent of holding in the Hudson a whole fleet of Dutch ships, laden with food, professedly for Holland and presumably for Germany, and finally commandeering them as an offset to the depredations of the freedom-of-the-seas-loving German.

It is well understood by all the Allies, and by nobody better than by President Wilson, that Germany reintroduced the phrase for the sole purpose of getting the thought into the public mind that the predominance of the Allied fleets, and especially of that of Great Britain, was a peril to the modern freedom of the seas. They wanted to instil the idea that Great Britain had created her vast navy, not for the legitimate purpose of acting as a bond to tie together the elements of her widely-scattered empire, but as a means of illegitimate control of the sea routes for her own individual profit, and as a hindrance to the commercial expansion of other nations.

The Attorney-General of the United States has recently warned us that there is an active and widespread revival of German propaganda. The warning is timely; for the enemy is working overtime in the effort to create jealousy, rivalry, and mistrust among the nations who are shortly to sit in judgment upon him. And in no direction is he more active than in his efforts to create suspicion of the lately-demonstrated strength of the British navy. "Beware!" whispers the Hun, "You see what she did to Germany; it will be your turn next."

Now what the British fleet did to German naval piracy and terrorism, was what it has done to every form of terrorism on the high seas for a century past—she crushed it out.

And when the Hun, the master mischief-maker of all the ages, points to the surrender of his whole fleet in the North Sea and cries "Beware!" none knows better than himself that this amazing spectacle was a crowning demonstration of the fact that today, as yesterday, the British fleet is the guardian of the seas against any such monstrous attack upon its "freedom" as that which the fleet helped so nobly to repel.

And if, in its Herculean task of holding the enemy in his own ports until the day of surrender, Great Britain has had to double the strength of a fleet, which was already a heavy drain upon her resources; and if in the effort to preserve the freedom of the seas and act as common carrier for the Allied cause, she has lost one-half of her vast merchant marine, she will bear both the burden and the loss without a whimper, content with the knowledge that, when Freedom called, the ships that fly the White Ensign were there to pay the price, staggering though it has proved to be.

The supremacy of her fleet is the "Monroe Doctrine" of the British Empire; indeed the maintenance of this supremacy is even more vital to her security than is the maintenance of the Monroe Doctrine to the security of the United States. A violation of the Monroe Doctrine would not necessarily imperil our existence as a nation; whereas it is well understood that a defeat of the British fleet would sound the death-knell of the whole British Empire.

Unlike the United States, which is entirely self-supporting and geographically a unit, the British Empire consists of an island, no larger than some of our smaller states, which is the seat of the Imperial Government and the heart of the system, with numerous outlying colonies and dominions scattered throughout the world. If the mother country be considered as the heart of the system, the trade routes of the world are its arteries.

Only so long as these arteries are unobstructed can the empire function. If Great Britain were blockaded and the trade routes of the world were controlled by an enemy, the mother country would be starved into submission in a few months' time, and the whole empire would fall like a house of cards. Hence she has laid it down that her fleet must always be of sufficient strength to preserve intact the great trade routes of the high seas. To insure this, she has made it her policy to maintain a navy equal in strength to that of any other two navies combined.

This policy is purely protective and has been accepted as such by every naval power except the one which recently aimed at the domination of the world. And in pursuance of her policy of preserving the freedom of the seas, she has followed a liberal course. Her ports have been open to the ships of all the world upon equal terms with those of her own merchant marine. She has charted the seven seas; and these charts, representing an outlay of millions of dollars, have been at the service of the whole mercantile world. Her markets have been open, without any restrictions, to the goods of her competitors in trade, including those of her greatest rival, Germany. She charges the same harbor dues and the pilot dues are the same.

In guarding the trade routes to her far-flung empire, she has, incidentally, preserved the freedom of the seas for the whole maritime world. Her record is clean and consistent; for free trade and free seas have been the indispensable corollary, the one of the other.

During and After the War

THE future may be read in the records of the past. The best index of one's fitness and capacity for assuming a commanding role in a new situation is found in a review of one's previous history. We have been asked by our readers what part the SCIENTIFIC AMERICAN is to play in the present reconstruction period. We may be pardoned, therefore, if we preface our forecast with a review of the service of the SCIENTIFIC AMERICAN during the past few years.

In the summer of 1914, the SCIENTIFIC AMERICAN was suddenly called upon for a very special service. A situation arose which few had anticipated. Europe was plunged into a war that threatened to involve the whole world. It was evident that this was to be a war of science on a scale never before approached. The great peace-loving public of this country turned to the topics of war, though all unprepared to discuss intelligently the technical features of the great conflict.

For seventy years the SCIENTIFIC AMERICAN had been performing the service of translating technical literature into everyday English, and naturally the public turned to us for authoritative information on military technology. We felt it our duty to supply this information and we supplemented our regular weekly issues with a series of special war numbers, endeavoring to keep pace, from the scientific point of view, with the progress of the war. A military expert was detailed to write the strategic moves of the war, and as the various apparatus of offense and defense was disclosed, we explained its operation in the language of the workaday world.

But the SCIENTIFIC AMERICAN had a further aim. It was our purpose not merely to satisfy curiosity, but to be a real help to the United States. We realized from the outset that it would be well-nigh impossible for America to keep out of the conflict; we were among the first to urge military preparedness. Then in those early days of the war came the great awakening of the American public to its dependence upon Europe, especially upon Germany. Suddenly cut off from products essential to our industries and our well-being, we found that Germany had a throttle-hold on our food, our clothing, our health, our very means of defense. Without the potash that came from German mines our agriculture suffered because we had purchased coal-tar products from Germany instead of making them ourselves, we were suddenly confronted with a shortage of dyes for our clothing and of drugs for our health.

A year before the outbreak of hostilities in Europe we had sent a special representative to Germany to study her industrial development. We had urged our people to pay more attention to applied science; and when the war broke out, the SCIENTIFIC AMERICAN pointed the way to American industrial independence. We started a war on waste. We urged thrift. We advised our manufacturers to search in the tail heaps for valuable raw materials. We endeavored to keep the public informed on methods of replacing German products by promoting American manufactures.

Not the United States alone was cut off from necessary products. The South American countries and the peoples of the Far East looked to us, greatest manufacturing country not immediately involved in the war, for the supplies that they had been getting from Europe. New markets called to America. The movement to develop a vast export trade was urged and fostered by the SCIENTIFIC AMERICAN. And the war was scarcely begun before we looked even further and urged preparation for the period of reconstruction that was to follow the war. Under the slogan "Industrial Preparedness for Peace," we published information upon the vexing problems which we foresaw at that early date, and thus laid the foundation for the great service that we are now called upon to perform.

Today, for the very reason that so much space in the SCIENTIFIC AMERICAN has been devoted to war topics, it is but natural for our readers to ask what future issues of the SCIENTIFIC AMERICAN hold for them.

Well, the technical history of the war has been only partly told. There is still a final volume to be written—a Book of Revelations. Gradually the carefully guarded secrets of the war, both naval and military, are being released, and as these are disclosed we intend to tell our readers just what inventions and ingenious methods were developed and used by the opposing armies.

But the more important service of the SCIENTIFIC AMERICAN will be to deal with the problems of reconstruction which have displaced the problems of war. In this country these problems will be largely of an economic nature; abroad they will be physical as well. We are making plans to keep in close touch with the work of reconstruction in the devastated areas of Europe, and while telling of the plans developed in this country to restore our industries to a peace basis, we shall also tell of the work done by our Allies and of its bearing upon our own problems.

Science has entered upon a new era. Never before have we realized its importance. It used to be that the university man was looked down upon by the hard-headed business man as an impractical idealist or a man filled with theoretical knowledge that had little value in actual practise. But the war has worked a marvelous transformation. It is realized now, as never before, that real progress is to be found in careful scientific research and that it is highly important for everyone, from the man at the desk to the man at the lathe, to keep in close touch with the progress of science. The SCIENTIFIC AMERICAN has established relations with the research bureaus of the leading universities of this country in order to obtain the latest information on the progress of science. Our Corresponding Editors in these universities will tell our readers of the latest advances. "The Service of the Chemist," a department which has been running for some time, will continue to recount the remarkable progress which America has made and is making in this branch of science. The development of our vast natural resources, particularly in the agricultural field will receive special attention in the SCIENTIFIC AMERICAN. Our department of "World Markets for American Manufacturers" will tell of the opportunities for the development of trade in foreign lands.

Just at the present time, the chief concern of those who have been devoting all or a large part of their efforts to the production of war materials, is to reorganize their factories for the manufacture of products pertaining to peace. We have received letters from a number of manufacturers who are seeking for some invention that they can take up in order to keep their plant occupied. On another page some of these letters will be found. It is our aim to publish such letters for the benefit of the general public and to help in the reconstruction of our industries.

And so to the question: What is the SCIENTIFIC AMERICAN going to do now that the war is over? we answer, that our aim is to be of real service to the country at large, and as the measure of our capacity to fulfill this service, we point to our unbroken record for the last seventy-three years.

Electricity

Dutch-Long Distance Radio Communication.—The site for the wireless station intended for communication between the Netherlands and the Dutch East Indies has finally been settled on, namely, the Koelberg hill, which is 86 meters high and located in Hoog-Buurlo, near Apeldoorn. A new railway line first of all is going to be constructed from Kaatwyk. The station is to have four towers, each 210 meters high, a large power house, and buildings for housing the operatives. The communicating station in India is to be built near Bandoeng in the Preanger, so that the distance between the two stations will be some 11,000 kilometers.

Formulae for Calculating Inductance.—Scientific Paper No. 320, issued by the Bureau of Standards, Washington, D. C., furnishes a list of formulae for the calculation of mutual and self-inductance which have appeared since the publication of the earlier paper dealing with the same subject, namely, Scientific Paper No. 169. Some of the formulae given, notably those for eccentrically placed circles, provide a solution for cases where none has been previously available; others are extensions of formulae already well known, or cover cases where earlier useful expressions were available. No attempt has been made to include all the recent formulae, but in making a selection the author has endeavored to present only those whose form is well adapted to numerical computation, or those for which tables have been prepared which render calculations reasonably simple. Those interested may obtain a copy of this Paper by addressing a request to the Bureau.

A New Application of Electrolysis.—A new, though small, industry has just been started in Valencia, Spain, according to *La Energia Electrica*. In this district a large number of small decorative articles are manufactured in clay, glass, wood, and papier mache. Some of these are now being encased in a thin "skin" of metal, which greatly improves the appearance and permanence of the articles. The method employed is simple. A small compressor supplies air at a pressure of about seven atmospheres to a receptacle filled with metallic powder, generally lead, for cheapness. At the moment the metallic powder emerges from the jet, it is melted by an oxy-hydrogen flame, and a spray of molten metal encases the object being "metallized," which is placed on a revolving platform. The object then goes to the electrolytic bath and receives its new skin of copper, silver, or gold. Glass articles are first treated by a sandblast to ensure the necessary roughness for the adhesion of the lead. A new type of Leyden jar is also being manufactured, in which the old silver-foil is replaced by a homogeneous film of silver.

The Skip-Stop's Excellent Results.—While it may be true that some among us have found fault with the "skip-stop" practice of many electric railways, whereby cars only stop at considerable intervals which are indicated by white posts, the saving effected has more than made up for the trifling inconvenience. During the first six months of the "skip-stop" system in 24 states, a saving of 687,122 tons of coal was effected. The greatest saving was in Massachusetts, where the estimated saving is 191,000 tons. Pennsylvania ranked second, with an estimated saving of 169,200 tons. Missouri saved 52,422 tons; New York, 50,000; New Jersey, 30,000; Illinois, 25,000; Ohio, 23,000; and Michigan, 22,000. Other states showing a saving of 10,000 or more were Tennessee, 18,000; Connecticut, 15,000; California, 11,000; Minnesota, 10,000; and Wisconsin, 10,000. In general, it is estimated that the saving effected by the "skip-stop" operation is one per cent of the total power used in operating the car. Aside from the saving in fuel, which of course has been the first consideration, there is the advantage of a considerable decrease in the time required for the trip.

Women as Electrical Welders on Ships.—Another advantage of electric welding over riveting in the building of ships was brought out recently when it was shown at the big Hog Island shipyard that women can become efficient electric welders. This means that the adopting of electric welding done by women on many of the smaller parts of ships will do much to settle the labor shortage problem. The women so far employed are proving very efficient and are enthusiastic over their work, and there is no apparent reason why they should not, with the proper training, supplant men in welding many of the minor parts. In nearly every line of work where women have been employed to relieve the labor shortage they have proved themselves as careful and painstaking as the men. As successful welding is largely dependent upon the careful manner in which it is done, they should prove successful in this line also. The instruction of the women and men welders, continues *Electrical Review*, is being carried on by the instructors returned to the various plants after completing the training course of the Education and Training Section of the Emergency Fleet Corporation. These men have been given several weeks' training and instruction in the schools organized by this section and have given very valuable service in the teaching of others.

Astronomy

A New Method of Determining Star Colors was described by E. S. King at the Cambridge meeting of the American Astronomical Society. By placing a pair of filters, say red and blue, in front of an objective and photographing out-of-focus images of stars, the disks of the images are produced half by red light and half by blue, and comparison makes it possible to measure the relative intensities of the two colors in the light of the star.

The Centenary of Father Secchi.—The hundredth anniversary of the birth of Angelo Secchi, the distinguished astronomer, was celebrated June 28th at his birthplace, Reggio Emilia, and at Rome, where his bust on the Pincio was adorned with a wreath, and a commemorative address was made by Prof. Pio Emanuelli. As director of the observatory of the Collegio Romano, Father Secchi took a leading part in the foundation of the modern science of astrophysics.

Radial Velocity of Nova Aquilae.—Messrs. Adams and Joy, of Mt. Wilson Observatory, announce that measurements of the narrow absorption lines H and K on 14 spectrograms, and of D_1 and D_2 on five spectrograms, indicate for Nova Aquilae No. 3 (the faint star which suddenly flamed out to first magnitude last June) a speed of motion toward our system of 15 kilometers per second. Measurements of 17 plates taken with the great new reflector of the Dominion Observatory, in British Columbia, give a somewhat higher velocity; viz, nearly 20 kilometers per second.

A Novel Map of Mars, in the form of a globe, is described and pictured in *L'Astronomie*. The globe was made in Denmark by Miss Ingeborg Brun, and has been presented to M. Flammarion, whose work on Mars inspired its construction, and who himself prepared two globes of the planet many years ago. It is 23 centimeters in diameter, and is painted in correct colors, as described by observers of Mars. All canals, etc., are shown, including the latest reported by Lowell. A point of touching interest in connection with this globe is that its maker has been a bed-ridden invalid for 20 years.

Novelties in Eclipse Observations.—At the last meeting of the American Astronomical Society Prof. E. B. Frost read a paper on "The Usefulness of a 'Movie' Camera for Photographing Phenomena of Solar Eclipses" and exhibited "movies" taken during the eclipse of June 8th, 1918. Some hundreds of photographs were taken at the rate of 16 to the second and were very successful. During the same eclipse Messrs. Kunz and Stebbins succeeded in measuring the light of the corona by means of the photoelectric cell. They found intensities up to about one-tenth the strength of moonlight, and their observations suggest the possibility that the presence of the corona might be detectable in daylight through clear skies.

Manuscripts of Sir William Herschel.—The grandsons of Sir William Herschel recently offered to the Royal Astronomical Society such of their grandfather's scientific manuscripts as the society might care to possess, and an examination of the papers was accordingly made by Mr. J. L. E. Dreyer. This examination revealed the existence of some interesting manuscripts not included in the edition of Sir W. Herschel's scientific papers published by the Royal Society and the Royal Astronomical Society in 1912. One of these, a series of observations on variable stars, is published in a recent number of the *Monthly Notices*. Other items include some detailed accounts of Herschel's experiments on the construction of mirrors for telescopes, various journals and reviews of observations, etc., and a collection of about 700 letters on scientific subjects addressed to Herschel.

A Solar Constant Station in Chile.—After various delays due to the war the Astrophysical Observatory of the Smithsonian Institution has succeeded in getting off its solar constant expedition to South America, and a permanent observing station has been opened at Calama, on the Loa River, in Chile, altitude 2,250 meters. Director Abbot believes that this region, near the Chilean nitrate desert, is the utmost cloudless region in the world easily accessible. Records for two years show no wholly cloudy days, and perfectly cloudless skies about two-thirds of the time. Winds are light and the rainfall is practically *nil*. The expedition, headed by Alfred F. Moore, is equipped with a full spectrobolometric, pyrheliometric and meteorological outfit. The main object of this station, like that of the other stations established by Dr. Abbot, is to determine the actual intensity of solar radiation received at the outer limit of our atmosphere, and to measure the fluctuations to which this misnamed "solar constant" is subject. The present expedition, when first organized, was unable to proceed to Chile on account of transportation difficulties incident to the war, and accordingly occupied a temporary station on Hump Mountain, N. C., but accomplished comparatively little on account of persistent cloudy weather.

Industrial Efficiency

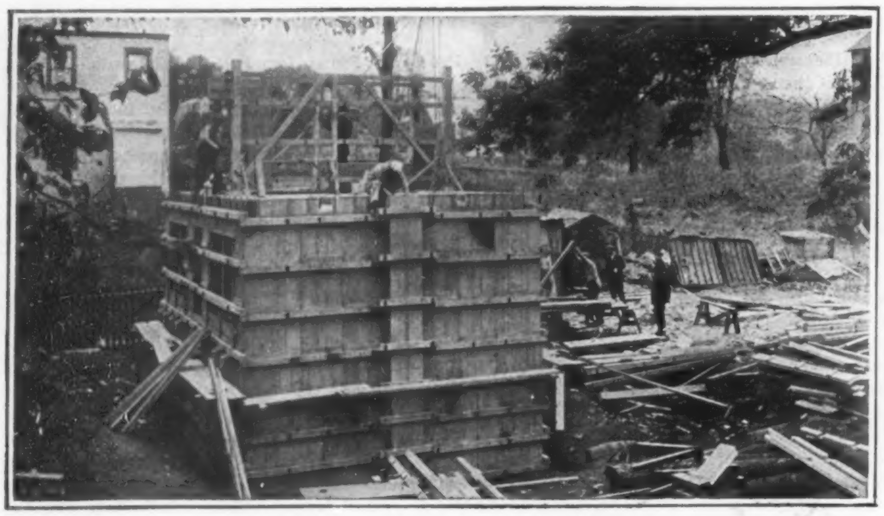
By-Products Plant for Pribilof Islands.—A by-products plant for the manufacture of oil and fertilizer from seal carcasses is being erected on St. Paul Island in the Pribilof Islands. The lighthouse tender "Cedar," which had on board some of the heavier portions of the equipment for this plant, arrived at the island on August 11th. The material was successfully landed, and ground for the foundation of the plant was broken a few days later. The remainder of the equipment for the plant was delivered by the "Roosevelt" later in the month. The carcasses of approximately 27,000 seals, which have been killed on St. Paul Island this year, will furnish ample material for preliminary operations.

Manufacture of White Lithopone in Italy.—A company in Milan, Italy, says the *Weekly Bulletin* of the Canadian Department of Trade and Commerce, has been formed for the manufacture of white lithopone, which is largely employed in the rubber industries and in the making of enamels and paints. This product was formerly imported from Germany, but Italy has the raw material necessary for its manufacture and a promising start has been made in the factory at Brescia. This beginning is all the more encouraging, as the process of manufacture is considered very complicated. It is even expected that a considerable quantity will be available for export. White lithopone has no injurious effect on the workmen connected with its manufacture, as has white lead.

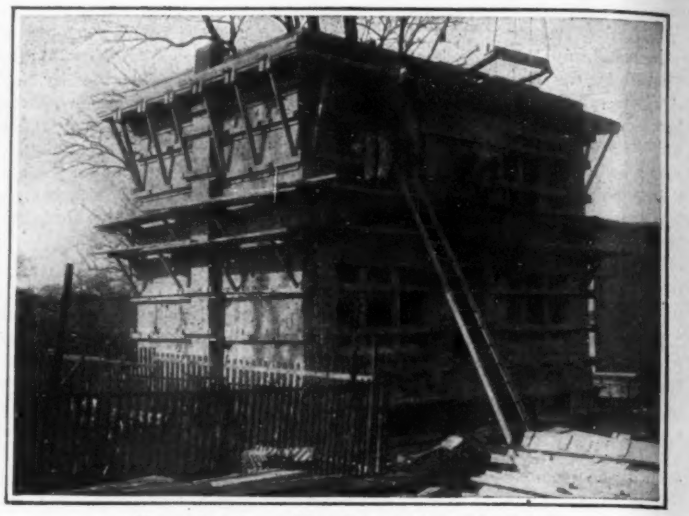
The Slavery of German Workers.—Control of labor power in German has been absolute under the old régime. The arrangement formerly in force there contrasted strongly with the present plan of control in America through the United States Employment Service. Just how each workman has been chained to his job in Germany may be realized when it is known that he could not change positions without the written consent either of his employer or of a board of seven members appointed by the military authorities. The board of seven included an army officer as chairman, two government officials, two employers, and two workingmen. The workingmen, therefore, not only had small representation on the board, but were denied the opportunity of choosing their own representatives. Any violation of the regulations concerning migration from one job to another was punished by heavy fine or imprisonment.

Multiplicity of Meters.—It is pointed out by *Engineering and Contracting* that there are in practically all city houses two meters—gas and electricity—and that in many communities a third is added to the list to record the water used. Each of these instruments is read once a month, and a bill rendered for the month's consumption. At present each meter is read by a different man, and the bills come separately, in different envelopes. Our contemporary suggests that even in cities where the three types of service are supplied by three or two different organizations, an arrangement could easily be made whereby all the meters would be read at once, by the same person, and all the bills rendered in a single envelope. Presumably all three bills could then be paid by a single check, forwarded to a sort of public-service clearing-house. The suggested saving to be effected by this conservation measure is $5,000,000 per annum, which would not merely be reclaimed from waste, but would soon go to the benefit of the consumer in some slight reduction of charges.

Intensive Training Plan of the British.—One thing that the war has demonstrated with utter conclusiveness is that long apprenticeships for mechanical work can be dispensed with if the emergency is sufficiently urgent. The Department of Labor's training and dilution service recognizes this principle. The apprenticeship system had taken a much stronger hold in England than it has ever obtained here, and when large numbers of Englishmen were called in the military service it was necessary to revise very radically impressions that had existed up to that time. The U. S. Department of Labor has been much interested in England's experiences along this line and has found them very helpful in solving American problems. The discovery of an untapped reservoir in women's work and the adoption of improved automatic and safety appliances in machines provided satisfactorily for the work which was not of a complicated nature. There were many jobs, however, developed by the war in which experienced workers were needed. The result was that intensive training was instituted by the great factories whereby men and women were instructed in the operation of complicated machinery and intricate processes. The way was shown by the initiative and generosity of a few individuals, who appreciated the problem. The Government then established a training section for factory workers in the ministry of munitions and some 50 colleges and schools were brought into the system. The courses led eventually to such advanced engineering work as lead burning, tool setting, and gage making, and were accompanied by measurement calculation.



Putting up the molds for the one-piece house



Removing the molds after pouring and setting

The One-Piece House

How the Cycle of Production Is Applied to the Concrete Cottage

By Bolton Hall

An Englishmen's house is his castle. An American's house is going to be his fireproof safe. Safe against damp, heat, cold and decay, not to mention earthquakes, painters, insurance premiums and other afflictions.

We have one-piece collar buttons, dresses, and pails—and now we shall have one-piece homes. For war is revolutionizing the housing of the masses. With Governments planning workmen's homes to cost $150,000,000, with private manufacturers at work on $100,000,000 worth more for their own employees, a vast new system of model residential construction is unfolding. It promises to lay the foundation for an era of world-wide realty investment and industrial development.

To provide real homes for returning soldiers and for our own workers and to repair the war wasted cities is a part of our reconstruction. The intensive cultivation of vacant lots and of small areas by wage earners led to a widely read book on "Three Acres and Liberty," which was the grandfather of our 2,000,000 war gardens. This plan could be extended indefinitely; but the difficulty hitherto has been to find a proper house for people of moderate means, who raise enormous crops on their quarter acres.

One well-known inventor tackled it, but the trouble with his poured house was that the iron molds cost too much (about $30,000 each), and weighed far too much and that the concrete stuck to the molds. The present plan gets over these difficulties by using laminated wooden molds, a set of which can be built in quantities for a few thousand dollars. They are light and will not stick to concrete.

One-piece concrete housing construction, on a wholesale basis, has been the dream of many another man, and numerous efforts have been made to make it practical. At least one manufacturer has succeeded in this. His main idea was to use the same general principles that govern the making of his dollar watch and of the cheap automobile; that is, to apply to house construction the cycle of production. This means to get your labor in harmony with your material.

By standardizing the house, workmen are trained to specialise on each of the individual operations, being then subject to the same speeding up that obtains in the modern factory. In order to do this, it was necessary to make the shell of the house in such a way that it could be reproduced over and over again in every detail, thus eliminating blue prints and all unnecessary work, delays, fads, fitting and errors in construction.

Concrete was adopted as the material, after trying out all others now used in building, because it is best adapted by nature and art to the scheme. The average person has been prejudiced against concrete by the fear of dampness. Dampness has been caused by lack of insulation and not by lack of waterproofness. It is a well known fact that when it is colder outside than inside, moisture will condense on the most waterproof surface—on a pane of glass, for instance. No waterproofing will correct this condition; the remedy is insulation against the external cold. To prevent dampness in the one-piece house, the insides of the walls are furred out and lathed so as to leave an air space between the plaster and the concrete-cast outside wall.

DAY	WRECKING HOUSE #11	POINTING HOUSE #11	CLEANING FORMS	CARRYING FORMS	ERECTING FORMS #12	MOVING HOIST & MIXER	CONCRETE #12	NUMBER OF MEN WORKING	REMARKS
MONDAY	40 hrs	16 hrs	8 hrs	16 hrs				10	started removal of main forms at 12 o clock.
TUESDAY	16 "	16 "	8 "	8 "	40 hrs.			11	
WEDNESDAY	16 "	8 "		32 "	40 "			12	
THURSDAY	16 "	8 "		16 "	32 "	24 hrs		12	
FRIDAY	8 "				16 "		64 hrs.	11	
SATURDAY					8 "		72 "	11	finished pouring concrete at 12 oclock.
SUNDAY.									setting time
TOTAL	96	48	16	72	136	24	136		
Started wrecking forms on Monday. These forms not set up but shipped to Phillipsburg N.J.									

The time chart showing record for a week. With a single set of forms, a gang of 10 to 12 men can produce a house a week, on this schedule, indefinitely

The main problem was to find the proper material for forms. Steel forms were discarded because of their weight, which rendered it difficult for one man to handle a section. Laminated cypress wood was selected as the most efficient. It is expected that the upkeep for the wood forms per house will not exceed $5 and indeed 15 houses have already been poured with the one set of forms and there are no signs of deterioration of the wood. Oil and paint and care make cypress wood almost everlasting, because the cypress tree is well used to damp.

The manner in which the forms are put together is interesting. Wooden posts are erected, well trussed, to bear the entire weight of the building. These posts sustain the wooden surfaces which come in contact with the concrete. Each mold is then subject only to the surface pressure from the weight of the concrete in that particular mold itself. The columns, continuous throughout the different stories and held in their positions by trusses, constitute an interior rigid framework for the two stories. On this supporting framework are hung the forms which mold the concrete of the outside and inside walls, the floor and roof construction, the cornice, etc. These forms fit into one another and reproduce each type of house which, to meet the requirements of wholesale reproduction, has been decided upon as a standard. The forms make it possible to reproduce this house over and over again, absolutely.

The one process yields an even thickness of the walls, perfect plumb and alinement, and the same interior and exterior dimensions in every case. There are no bolts or other means of taking up the discrepancies that are usual in erecting interchangeable single piece lumber forms. These forms are non-interchangeable; every piece has its allotted place, and where it is not self-locking it requires only the driving home of a wedge in order to bring it to its true position.

Each piece of form work is adapted to perform a certain operation, and bears a mark which designates its proper place. The only skill needed in erecting the forms is learning the meaning of the marks. This enables the entire operation to be accomplished by common labor. The forms are kept from bulging by iron bars which extend through forms and wall, so that the structure is rigid before any concrete is poured. The iron tie-rods are provided with two hemispherical pieces of iron which rest on each side of the wall next to the forms. When the forms are taken down these hemispherical pieces are removed and the tie is cut off. The small hole left is then plastered. The wooden facing blocks are also left in the wall, being plastered over in the same manner as are the tie-rods.

Ready for the front steps

The finished product

The high cost of living includes an increasingly high cost of a house to live in, and of land to live on. Experience under the present abnormal conditions, which of course greatly increase all costs, has shown that a thousand-dollar house is entirely feasible, under normal conditions and normal prices.

The chief objection made to a wholesale scheme of housing is the similar aspect of each building. But dwellers in city blocks are accustomed to houses which exactly duplicate their neighbor's, and there seems to be no reason why the country dweller should not find the same scheme to his liking. Dissimilarity of appearance, however, is secured in one case by varying colors and

approaches, and by grouping the houses.

The project was tried out in South Orange, theoretical ideas being modified as circumstances seemed to require. After the forms were thoroughly tested, the originators decided to build forty houses in Union, N. J., in order further to develop the cycle of production in each department of this building. Now one company contemplates 1,200 houses, and has ordered concrete molds for the first hundred.

All the materials for the complete house are sent to the job cut to the right length and properly marked as to position. They can be placed without working out any problem in carpentry, or any other trade. This eliminates much waste of time.

Reinforcing iron rods are placed in the form before the house is poured. The vent and soil pipes, electric conduits, flue lining for the chimneys, window frames, door bucks, furring strips, nailing blocks, etc., are also set in place before the concrete is poured. Water supply pipes are exposed, plumbing being modern in every respect.

The concrete for the lower story is poured through window or door openings, thus eliminating the danger of separation of the aggregate from the cement, which would be liable to occur if the concrete for the entire house were poured from the roof.

The shell is then a monolith of reinforced concrete. It is made up of outside walls, interior partitions, beams for the floors and roof, casements and door frames embedded in the walls. It has flat arches spanning between beams, and solid concrete chimneys, cornice and parapet.

The exterior can be either covered with stucco or the form marks can be removed by the rotary finisher. Then the hoods for the front and rear doors and also the front and rear steps are attached. The roof is watertight, finished by a coat of hot asphalt. This is all the finishing necessary for the exterior of the house. On the inside the walls are furred and lathed. Either wood or metal lath can be used to hold the plaster. Wood sleepers and floors are laid, the stairs are put in, and the sash and doors are hung. The trim is then set and painted or stained as desired. The plumbing fixtures consist of lavatory, bathtub and water closet in the bathroom on the second floor, and a sink in the kitchen. This completes the interior of the house.

Cypress trim finished natural is used, the floors being of North Caroline pine. The bathroom has a white cement wainscot and cement floor. The doors are of fir, stained natural and varnished. Hardware consists of an ornamental front-door set, an iron lock for the rear door, and wood knobs on interior doors.

It takes about seven hours to pour each house. It takes about three days to erect a set of forms, and two days for taking them down, so that the forms are removed at the end of a week. It is estimated on the basis of the work done on the tract at Union, N. J., that each set of forms will produce at least at the rate of fifty houses a year. Ultimate performance may be much better; but the organization is perfecting the cycle of production, and is not attempting a speeding-up process until this is perfected.

There are no limits to the size or height of the house. To get the greatest economy one design should be reproduced as often as possible, thus reducing the pro rata cost of the forms. And as the window frame, plumbing and other items can be purchased cheaper in quantities, there is still a greater saving in one standard design. As to larger house sizes, while it is the present purpose to confine initial efforts, at least, to workingmen's houses, the manufacturing process will apply to any size.

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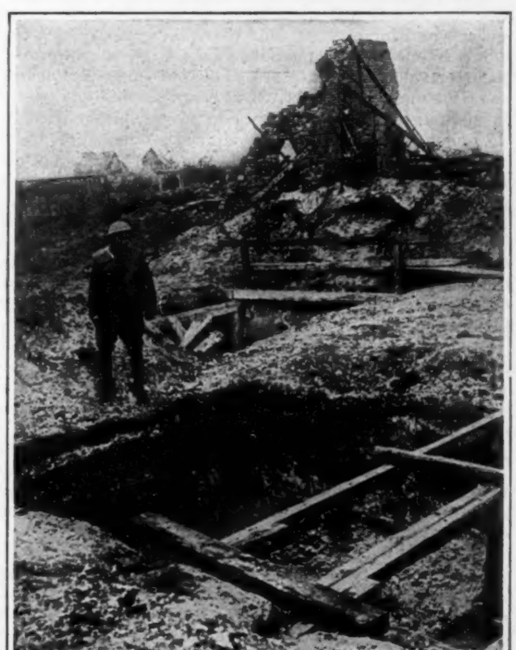
Wrecked British tank employed by German army engineers as a foundation for a temporary bridge

The house already developed, is roughly 16 by 24 feet; there is another plan 24 by 24 feet which, while giving 50 per cent more space, will not cost for forms or house construction, anything near 50 per cent more. This is according to the building axiom that economy is in relation to the approach to a cube. So, while the form itself will cost more, it will cost less in relation to the finished product.



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German anti-tank pits which failed to halt the British

Some Oddities of Trench Warfare

DURING the last days of the great war the Germans endeavored in numerous and divers ways to hamper the tank fleets of the Allied forces. For there is no mistaking the fact that they finally came to appreciate the effectiveness of the tank; and their persistent ridiculing of the tank idea for so long a time only served to make it impossible for them to catch up with the Allies in this branch of modern warfare.

Among the numerous devices of the Germans to halt the advance of tank fleets were nests of pits in front of their positions, of the kind shown in one of the accompanying illustrations. These pits of several feet in depth, were covered over with a light wooden framework and camouflaged canvas so as to lead a tank pilot to believe that solid ground was ahead of him. Again, the Germans dug deep and wide trenches in front of their lines so as to prevent tanks from passing. Still another device was the use of heavy cement pillars, spaced so as to permit passage to the German infantrymen but barring the way to even the smallest tanks. A similar arrangement called for a large number of railroad rails imbedded in cement.

Despite all such devices and concentrated anti-tank artillery and rifles, the Germans could not stay the advance of the tanks, which always found a way of getting around obstructions of all sorts. For one thing, the Allies varied their form of attack, switching from the heavy artillery bombardment and infantry attack to the short crash bombardment and surprise infantry and tank attacks, so that the Germans often made their anti-tank preparations uselessly.

As to what the Germans did with the numerous tanks which fell into their hands, the other illustration is interesting. It shows how the German engineers made use of a wrecked British tank for the purpose of throwing a temporary bridge over a canal in France.

Antimony in Transvaal

A NEW body of antimony is reported to have been opened up near the Komati River, in the district of the Stenysdorp gold fields, Transvaal. As the ore is found to be valuable, a mining company is now carrying on smelting operations on the spot. Three shafts have been sunk to a depth of 50 feet, besides open workings. Ore is continuous throughout. A furnace capable of smelting 10 tons of ore per day is in operation, and it is stated that there is sufficient ore in sight to keep the furnace working while developments are being made.

Odd Treatments for the War's Afflicted Soldiers

SOME highly interesting treatments are being resorted to at the Grandville Canadian Special Hospital of Buxton, England, in the curing of trench feet and stiff hands. It is in that institution that many British soldiers are treated and finally cured, so that they leave fully ready to take up their usual civilian labors.

Two of the treatments followed at the Grandville Hospital are depicted in the accompanying illustrations. The first of these shows the odd treatment for trench feet, which consists of a simple exercise for the toes and makes use of a wooden cross piece and a pair of reins. By pulling on the reins the patients are able to exercise their toes, which gradually regain their normal strength. The second illustration shows the patients engaged in rolling cigarettes, which task is at once useful and highly curative. Slowly turning out the work at first, the patients steadily gain speed in rolling the cigarettes until their fingers are restored to their normal nimbleness.

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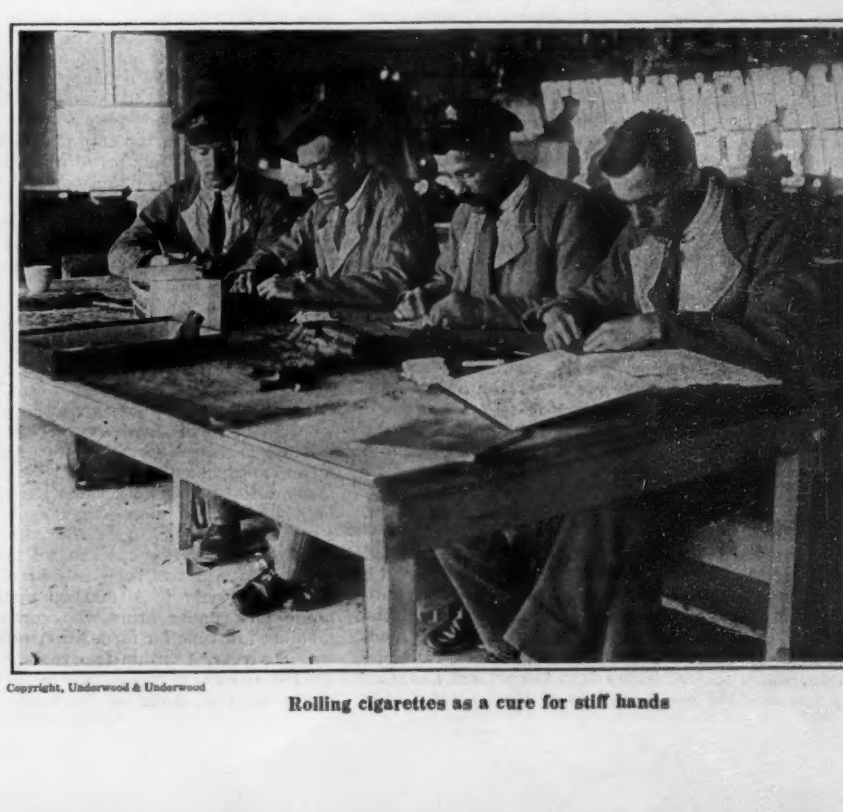
An interesting and effective cure for trench feet



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Rolling cigarettes as a cure for stiff hands

Economics of Peace

Factors of Men and Ships That Will Continue to Dominate the Food Situation

AS a nation, we laughed at, rather than resented, the wheatless day, the meatless day, the war bread, the sugar shortage, the high food prices. We were sending an army to France and we thought nothing of our slight hardships as long as they were fed.

But there are many who resent the prospects of less food in a time of peace than they enjoyed in a time of war, and who, merely for lack of understanding the matter, protest against America continuing to be the food reservoir of the world, from which drafts can be made by those countries which have capitulated to the Allied arms.

To argue that humanitarian considerations make it essential that we, who have the food, must share with Germany, Austria, Turkey, Bulgaria—our enemies—makes small impression on those whose memories of our foe's inhumanity is keen. Luckily for them, economic reasons demand the feeding of our defeated enemies—economic reasons of the highest importance.

Put baldly and briefly, Germany and her allies must pay a big, big price for their war. France has already totalled a bill of 68 billions against Germany, of which 13 are the billion tribute she paid in 1871 and interest on that sum to date. Germany and her allies cannot pay if they do not remain nations, if their people die of famine, if they have no food. They have semi-starved for four long years. To rehabilitate their shattered industries—which they must do in order to be able to pay their monetary debts—they must be fed.

We have the same necessity to feed our own people, our soldiers (whether they are abroad or at home) and largely to supply our allies, which has existed during the war. France cannot cultivate her fields and get a normal crop yield in less than a year, if within that time. England has always been fed by boat. The demands made upon us by devastated Belgium must continue for some time, not to mention Serbia. Add to these the calls which come from our prostrate enemies, and it is easily seen why food prices must remain high, and why food conservation is perhaps more important now than ever before.

This is not the snap judgment of this writer, but the mature pronouncement of men in authority. For instance, the Secretary of Agriculture, states that "for a considerable period, the world will need particularly a larger supply than normal of live stock, and especially of fats. We should not fail, therefore, to adopt every feasible means of economically increasing our live stock products. As a part of our program, we should give due thought to the securing of an adequate supply of food stuffs and to the eradication of all forms of animal disease."

That we must conserve food as we have not conserved it during the war is also a matter of figures, which might be appalling were it not for the fact that we have proved to ourselves that there is no emergency to which we cannot rise, if we are only awakened to the need.

Take the period between July and September as an example—in 1917 our total exports of beef products were a little short of 94 million pounds. In the same period in this year we exported almost 172 million pounds of beef. Our pork products exports increased from 196 million to 541 million pounds, our grain from 66 to 121 million pounds, and so on. In beef our three-year pre-war average exports were 186 million pounds. The fiscal year 1917-18 saw 565 million beef pounds go out of this country. The three-year pre-war average of pork was 996 million pounds while the year 1917-18 saw 1,691 million pounds shipped out! Grain almost doubled (183 million against 349 million) and as for sugar! The three-year pre-war average export of sugar was 621 million pounds. The 1917-18 shipments were two billion and the year previous three billion pounds—no wonder we are on a sugar ration.

It has been falsely stated that the opening of the Dardanelles should afford relief as far as grain is concerned. But how can the presence o- absence of a trade artery affect food supply if there be no food to flow through that artery? Germany found no wheat in Russia; how can she—or the rest of the European hungry hordes—find it now?

Others say that because of the release of shipping, South America can help bear the burden. Doubtless this is so in some measure, and the 400,000 tons of Dutch shipping lying idle in European ports throughout the war and Germany's 1,500,000 tons of idle ships in neutral harbors and her 2,400,000 tons in her own ports will be of great service. But South America is far away and Australia and the Far East are still farther. There are two million men to be transported in the near future and Europe is crying for materials to manufacture and steel to reconstruct almost as much as she will cry for food. Argue as one will, there is no escaping the fact that America faces a food shortage greater than that caused by the war.

This is well recognized by the Food Administration. Hoover didn't go abroad to study the food needs because he wanted a trip—he went because he knew the United States had to feed itself and feed the rest of the world, too. And the Food Administration has stated the problem in no uncertain terms. It says the ending of the war must make no difference in the saving of food. This is the message of the United States Food Administration, whose leaders realize that the present situation only increases the responsibilities of the United States. Under any circumstances the nation is bound by the food pledge of August, 1918 "Make your plans for victory," the Allies were told. "America's contribution among other things, will at least be 17,500,000 tons of food; probably more because of the necessity of helping to feed the people of conquered nations."

Sending 17,500,000 tons of food means saving—it can be done in no other way. It means intensive saving of all food, as wheat was saved in the wheat emergency, as sugar was saved in the sugar emergency. The American people had been accustomed to four or five pounds of sugar a month. Last summer they were informed that three pounds a month must suffice. They were hardly adjusted to that allowance when it became necessary to reduce consumption to two pounds a month.

The point is that cutting down the sugar ration from four pounds to three caused no privation and cutting it again to two pounds made no real suffering. What happened was that every one measured his sugar carefully and made every spoonful count for essential food or flavor—none for waste or indulgence.

Naturally the Food Administration would say that only by saving can the new demands be met. It has accomplished so much by its appeals for saving that it would naturally turn to conservation as a first aid in the growing emergency. But there are other methods, and these are also to be tried. For instance, the greater need for food-fats and meat will be met by an increase in cattle raising. There can be no question that the cattle raisers are already making plans for a much greater production of beef.

The war and its universal demand for greater production has necessarily made an impression upon the stock raisers, and for the last four years there has been a big effort to meet the demands. To charge the improvement in stock raising to selfish reasons may perhaps in some instances be correct. But there are many patriotic farmers in the United States who have honestly tried to do their share toward upholding the honor of their country and bringing an end to the most horrible of all wars, and to the patriotism of these the Food Administration looks for a continuance of well doing. The government has given the farmers a great incentive for increased stock production by its recent action in providing payment in compensation for tubercular cattle killed by order of the government. Tuberculosis has been one of the most serious problems with which the farmer has had to deal. Thousands of cattle have been killed by the government because they suffered from the disease, and while few farmers condemned the Federal authorities for their action, it did not altogether seem right to them that their animals should be slaughtered without any remuneration. The new law, which provides for compensation for cattle killed by government order because they are suspected of having tuberculosis, will encourage farmers everywhere to give more attention to the raising of cattle. The result should be a marked increase in beef production.

That this encouragement comes just in time may be gathered when it is understood that peace wi'l bring some 200,000,000 new mouths to us to feed. That we cannot do it entirely either by saving or by increased production, but must to some extent meet the demand by absolute denial, is shown when consideration is given to the figures of available live stock. Recent statistics show of live stock on farms: cattle 66,830,000; sheep 48,900,000; hogs, 71,374,000. This is not greatly in excess of the normal figures. In 1913 there were 56,527,000 cattle, 51,482,000 sheep and 61,178,000 hogs. Our exports have gone to an unbelievable figure. Exports of bacon in the first seven months of this year were not far from being equal to the total bacon exports for the five years preceding the war.

Of course, meat is only one item. Cereals and vegetables are certainly of equal importance. But these two can never be considered together, because an increase or a decrease in the food grown in the ground is so much more rapid than in the case of live stock. One cannot produce a herd of full grown cattle in a single season—one can, if one will, double or halve a wheat area, for instance, in a few months.

How rapidly we have increased our cereal and vegetable yield is well shown by a comparison of the previous five-year average with this year's crops. Expressed in percentages, we have produced 41 per cent more wheat this year than in the previous five-year average. Oats are 18 per cent greater, barley 17 per cent, while rye increased 72 per cent, of course because of the demand for a satisfactory adulterant of wheat flour for war bread. Sweet potatoes increased 39 per cent, rice 45 per cent, tobacco (hardly a food but as vital to working efficiency as wheat) 22 per cent, while hay, cotton and corn decreased.

These increases seem fairly to represent as much as might be expected of farmers who have been obliged in many instances to work short handed. They can perhaps do a little more—they cannot do much more. Farming is largely a matter of capital, of kind of land, of climate. But it is absolutely a matter of man power. And the world has been robbed of much of its man power, not only in 10,000,000 casualties, but by the horde now under arms who cannot possibly be demobilized in time for farm work, productive farm work, within a year, if within two years. Clarence Ousley of the Department of Agriculture found out that on account of the labor situation on the farms, crops of 1918 were harvested only by calling upon men of farm experience residing in the towns and cities to go out into the country and help the farmers with their tasks. In the wheat belt twilight squads were organized: business men left their offices at 4 o'clock and went out and worked in the fields until 9. In the fruit regions the whole population went out and helped pick the berries or the apples. In some places stores were closed for a day or two during the week; in others stores were closed a half day for a whole week or for two whole weeks; in other places two or three days during the week were given by the clerks and the porters around the stores and the shops. These activities are not so likely to be maintained under peace next year as they were under war patriotism last year. Agricultural production on a basis of the profit it offers is bound to come back and very soon.

Several years will be required to bring about a readjustment of economic and industrial conditions. Many countries have been devastated; their labor has been more or less decimated and the demand for the physical reconstruction of the cities, of roads and of public works will be so great and wages probably so high that it may be that few will be inclined to go back to the farm. It is altogether possible that for a few years following the complete restoration of peace there will be a lack of normal production. Farmers and their families who have exerted themselves to an unusual extent to produce for war purposes may not be so much inclined to exert themselves to an unusual extent in peace times. Certainly women, who have done much farm labor, cannot be expected to make beasts of burden of themselves indefinitely. Not long ago a farmer's wife wrote the Secretary of Agriculture for some advice. To justify her in her request, she told something of how she was helping produce food. In her letter she said:

> "July 2. I cut an acre and a half of peas and my husband pulled them back, and July 3 we had an 8½ pound boy. Since then I have been tied to the house more or less, but by getting the little neighbor girl to tend baby I cut 12 acres of hay across the road on another farm while my husband was helping my father draw in grain. He has to drive 4½ miles when he changes work with him."

That is certainly patriotism raised to the highest power—as great a patriotism, perhaps, as that of the French mother with three sons dead on the field, sewing for the Red Cross, who hears of the death of the fourth and last son, nor drops a stitch as she says only "*vive la France!*"

But one cannot expect such efforts in time of peace, nor from American women when they know that the thing which will make it unnecessary is merely self-denial and conservation on the part of the food consumers.

The answer to the food problem, the high price problem, must come from food administration, food conservation, the substitution of foods which we like less, perhaps, but can use, for those which we like more but which must be sent abroad. We have got to worry through the next year, perhaps two years, with only world patriotism as an urge, and with no great prospect of any relief from high prices or food scarcity to look forward to, until (1) Europe is to some extent reconstructed (2) European men can retill, resow, rereap their fields (3) our own army is demobilized and our farmers are able to work with a normal supply of labor and (4) the world's supply of ships is relieved of the task of carrying materials and men, and can be largely devoted to the transportation of foodstuffs, so that other countries, farther from the scene of need, may contribute their share towards feeding the mouths left hungry by war. No matter how we try to increase production, the limiting factors of scarcity of labor and of time make it absolutely essential that the Food Administration continue its laws and regulations, and that we, who have yet to know hunger because of the war, be content with a modest menu and the knowledge that it is of small use to make a world safe for democracy if the peoples so instructed die from hunger or erupt into anarchy worse than death, because of lack of food we can spare, even at the cost of some discomfort to ourselves.

Magnesium as a Substitute for Tin

ATTENTION has been drawn to the possible use of magnesium as a substitute for tin in brass or bronze valve boilers. This is a comparatively new use for magnesium, and though it is not a substitute for tin in all particulars, it is effective in producing a dense metal free from oxides and blow-holes. The amount of magnesium used in this work varies from .05 to .1 per cent, and one pound of magnesium will deoxidize from 100 to 2,000 pounds of brass or bronze.

Though the principal action of magnesium is to deoxidize, it has the additional effect of making a denser casting and a stronger metal. It is introduced into the mixture after the brass or bronze has been removed from the fire and is plunged by means of iron tongs or a "phosphorizer." Slow stirring should be continued after the metal has melted from the tongs, to insure a uniform mixture and to give the oxide of magnesium an opportunity to rise to the surface.

Magnesium also makes a more fluid metal, so that more difficult castings can be poured than without its use. Its deoxidizing qualities also eliminate the necessity for the addition of phosphorus.

Spotting the Shots

More Than Abstract Mathematics in the Business of Directing a Battery

By C. H. Claudy

THE Russian is not the only revolution to grow out of the great war. The practice of artillery at the front has undergone as great a change as the darkest country, and in no respect has this change been greater than in the methods of observation of the work of the big guns. For no previous war had airplanes, and those in which balloons were used had not the perfection of apparatus which distinguishes the use of the "sausage" today.

The smaller the target at which a long-range gun shoots, the more necessary is it to have competent observation of fire. Give a good battery plenty of time before it shoots, and, as a general rule, the target will usually be found inside the zone of dispersion of the shots of that battery as fired from the initial data prepared from tables, maps, calculations and orientation. But nothing can overcome the fact that guns, ammunition, atmosphere and general conditions are seldom or never entirely "average" or "standard" and that the most careful calculation will sometimes fail because of the error caused by such factors as these, which are beyond human control. Then indeed does observation become absolutely essential if hits are to be made (and the whole function of any battery is to make hits).

There are four methods commonly used in observing artillery fire—airplane, balloon, terrestrial and by sound. Of these, the first is the most expensive, difficult, and, in many cases, the best; the second is good for shorter ranges, but difficult or impossible for very long ranges, the third often the only possible means when wind or clouds make aerial observation impossible, and the fourth is a somewhat new idea, of which no details can be obtained. It is based of course upon the time of arrival of sound waves having a common origin at two or more stations the distance apart of which is known. It is rather surprisingly accurate, often running as close as fifty and even twenty-five meters, but of course requires a comparatively quiet sector for its employment, and very accurate checking. It is of more use in locating enemy batteries than in spotting shots from one's own.

If, as is undoubtedly true, aerial observation from an airplane is the best of all methods, it is a fair question from the non-military reader as to why any other method is ever employed. And to answer "expense" is not to answer, for war regards not cost. However, ruthless as war is, it does attempt to conserve lives, especially highly educated specialist lives. The pilot and observer in a plane are very expensive to train and hard to get. The temperatures in which they work, the dangers to which they are exposed and the strain of the work make it impossible for any plane crew to work effectively for long periods. With the difficulty of getting planes and aviators and educated observers, it is obviously the part of wisdom to employ every other method of observation first, and resort to airplane only when no other method will do.

It should be remembered that, be the skill of aerial observers what it may, the method of visual observation from a single viewpoint—and that one a constantly shifting one—is seldom accurate. With a plainly visible target, on a clear day, an airplane which can get somewhere near the target can of course report "over" or "short" and by reference to a map or photograph of the terrain and the scale, determine with remarkable precision the amount of deviation. But airplanes can by no means always get over the target and the target is by no means always clearly visible. It is one thing to shoot at a village, a huge ammunition depot or a cross roads, and quite another to search out a hidden battery in a wood, a concealed headquarters or a target behind hills which is unapproachable because of enemy battleplanes.

The method of observation which is entirely accurate is terrestrial, of course. Observers on the tops of two hills, or trees, or churches, at known distances apart, who can get the angle subtended by a shell burst, can provide data from which the exact spot at which that shell burst can be determined on the map. In all cases where there is any possibility of terrestrial observations a battery will have them, even if depending mainly upon the plane. Indeed, no good battery does with less than two methods of observation if it can obtain them, the one serving as a check upon the other and the two together often forming a fairly perfect whole when the inaccuracies of each method do not overlap.

The methods followed are extremely interesting, and show how ingenuity has overcome the difficulties which practice presents to theory. For spotting a shot on a gun range is one thing, and picking out one particular shot among thousands, and making sure that the data which comes back applies to your own particular gun and its one particular shot and not to some other gun and some other shot, is quite another matter. If war were a matter of one gun—but it isn't!

No battery firing at long ranges expects to make hits with its first few shots. A gun must be "warmed up" before it will function according to calculation. The inescapable errors must be corrected by observation. But the "fire for adjustment" for the sake of both time and material economy, must be as short as possible, and to this end, it must be conducted so as to give the observers every advantage. Thus, it is customary, so that the observers can clearly distinguish one shot from another, to fire at not exceeding a definite and predetermined number of shots per given time interval. During fire for adjustment it is not customary to fire more than six and often only four shots per minute.

The observers must know when the shot is fired for several reasons, chief of which is that if they don't know when it is fired, they don't know when it will land and burst, and not knowing that, they may easily report some other shot from some other gun. When the observation is by balloon or plane, the observer aloft sends the signal "fire" and expects the shot to be fired within thirty seconds of that signal. He knows in advance just how long the shot will take to go from gun to target, and can thus judge very accurately whether the burst he observes is from the gun for which he is observing or not.

A curious little point has been developed in observation work, which demands that observers do not watch the target closely while waiting for the shot to strike. To do so is to tire the eyes and make accuracy of observation impossible. Knowing when the shot is fired, and how long it takes, the observer keeps his eyes "rested" by looking at nothing with any degree of fixation until just before the shot should land. Then he fixes his eyes on the target. This not only brings an untired eye to the burst, but aids him in observing the right shot.

In terrestrial or balloon observation, where a telephone connection is established between battery and observers, the battery tells the observer "shot fired" and then again warns him in seconds before impact, thus "Ready—ten—five—now!" The observer should see the burst

(Continued on page 485)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Proposed Radio Control

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to congratulate you on your timely editorial in the issue of November 30th against the proposed huge increase in our Navy,. I have heard others express the same astonishment experienced by you and myself. I have always been for a strong navy, but there is reason in all things.

Scarcely less distressing is the bill now before Congress, which would spend several millions more for the purpose of setting Mr. Daniels' Department up in the commercial radio business to the exclusion of all others. You know what a naval monopoly would mean to radio from the point of view of the scientist and inventor, and several of your readers would be pleased to see this subject also aired in your editorial columns.

You have always championed the free development of radio, and this policy has been amply vindicated by the war. As soon as it can be gathered I intend to send you data on some of the service rendered the country by amateur radio men.

JOHN V. PURSELL.

[*On the receipt of this data we shall have something to say on the question of radio monopoly.*—EDITOR.]

Billions or Brotherhood

To the Editor of the SCIENTIFIC AMERICAN:

Why should it be necessary for the United States to spend more billions for naval construction, when the combined navies of Italy, France, England, ourselves and Japan are supposed to be combined against any nation, or nations, that may be willing to risk the fate of Germany?

If this is a reasonable question, I shall be glad to read your answer in the columns of the SCIENTIFIC AMERICAN.

WM. H. BAUMGRAS.

[*Our protest against taking the place of Germany as the pacemaker in naval construction will be found in our issue of November 30th.*—EDITOR.]

"Abnormal Profits" Should Cease

To the Editor of the SCIENTIFIC AMERICAN:

Allow me to commend your editorial of November 30th "Peace and Naval Policy" with which I heartily agree.

While the war lasted we were willing to make every possible sacrifice for the sake of the cause and to lend our money to the Government in the form of "Liberty Bonds" and "War saving certificates", to the point of great personal sacrifices, notwithstanding the fact that it would go in large measure directly into the pockets of persons already making abnormal profits out of the war industries. Now, conditions have changed and the "abnormal profits" of the great steel companies should *cease*, absolutely. It is the man on a small salary who has been the sufferer financially, and who has been called upon by the Government to make the greatest sacrifices; for in many cases he has gone into debt for the sake of the cause. Is his patriotism now to be rewarded by a continuation of the burdens, and the continued swelling of the frankly acknowledged "abnormal profits" of steel companies? Such things cannot well be continued now that the extreme exigency has gone, without causing nation-wide dissatisfaction and unrest.

And are we now, indeed, about to play the role of Germany at the Peace Conference? Is Germany's action at the two Hague conferences to be forgotten?

HARRY D. TIEMANN.

Kultur

To the Editor of the SCIENTIFIC AMERICAN:

Last evening I read, reread, and pondered your editorial entitled "Kultur" in the November 2d issue. Whatever the editorial columns of the SCIENTIFIC AMERICAN present to me always commands my interested attention, and usually because of the lucidness and intelligibility, but for once you have me guessing somewhat helplessly.

If "Kultur" is correctly defined as "the addition of purpose and intent to Nature's program of evolution," and Nature's program is really lacking purpose and intent, the aim of "Kultur," however mistaken its means, should certainly be welcomed as laudable. If, however, purpose and intent are not lacking in Nature—and the fact that she is credited with a "program" suggests that they are not—then the criticism of "Kultur" might well be that it was blind to what is and, therefore, fundamentally astray.

That the program of Nature, "is a simple one," even though defined as "a struggle for existence," may be reasonably doubted unless one is satisfied as to the purpose and intent of *existence;* and to say that the "pressure of Nature" upon the individual "is indiscernible," yet "ruthless perhaps" though "cruel never," is a contradiction of fact and a complication of theory that is inimical to sane thinking—at least, to my way of thinking.

Are we not prone, in our use of words, to lose ourselves in a vicious line of thought which tends to carry us dangerously away from the substance of that which moves us to think? In my thinking the reference point of all its thought is the nature of "purpose and intent" rather than the purpose and intent of "Nature," and, though none of the words I use may be conclusively defined, the order of their use is significant of the method by which I arrive at conclusions, and the use I make of my conclusions defines them in all possible clearness.

I do not need to split hairs, nor to juggle words, in condemning "Kultur" as it has been imposed upon us. Whatever its purpose and intent it has been offensive to us, and we have resisted it with all the resources at our command, even to the extent of using some of the worst as well as some of its best methods. It has been up to us to prove that "freedom" was more powerful than "Kultur," and now we have to prove that it is better. May that be "the noble pastime" in which we shall engage.

HAROLD W. STEVENS.
Washington, D. C.

That Langley-Manly Engine

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue for November 30th, 1918, a letter from Mr. Elwood Haynes, of Kokomo, Ind., in which he takes exception to the statement that the Langley-Manly aviation engine of 1901 was nine years ahead of its time in the matter of power output and sixteen years ahead in its weight per horse power. Mr. Haynes is evidently unfamiliar with the history of this particular aeronautic engine, since he makes the erroneous statement that the power used was steam.

As the author of the note on Evolution of the Aircraft Engine, I wish to call Mr. Haynes' attention to the very complete description of this engine which is given on pages 234 to 250 of the Langley Memoir on Mechanical Flight. It will be there noted that this engine was complete in December, 1901, and that it afterward underwent a continuous endurance run of 10 hours during which it developed an average of 52.4 horse-power at 950 r. p. m. The weight of this engine complete with carburetor and ignition equipment was approximately 152 pounds. Its production at that early date, and under the difficulties then obtaining, constituted a marvelous engineering and construction achievement and as such deserves a degree of recognition which has apparently never been accorded.

In *Aviation* for November 15th, 1917, will be found a rather complete description of the trials of the Langley "Aerodrome" in the year 1914 by Mr. Glenn H. Curtiss, in which it is interesting to note that the original Langley-Manly engine proved itself capable of lifting the "Aerodrome" and of making sustained flights, although the weight of the machine had been materially increased by the addition of the necessary pontoons for water use.

It is hoped that you will endeavor to correct the erroneous impression which Mr. Haynes' letter tends to create, in order that a brilliant piece of pioneering shall not be depreciated.

LEIGH M. GRIFFITH,
Senior Staff Engineer,
National Advisory Committee for Aeronautics.

Our Navy's Winged Destroyers

How the U. S. Navy Quietly Went About the Work of Establishing the First Government-Owned Aircraft Plant for Supplying Giant Seaplanes

By Austin C. Lescarboura

Article and Photographs Passed by Naval Censor

THERE is more to the story of our aeronautical effort in the great war than the achievements of the Army and the numerous private aircraft constructors. That side of the story has received full and just publicity. But there is another side, forming a smaller yet none the less important part, which has not been told until now, and that is the great work of the United States Navy in the air.

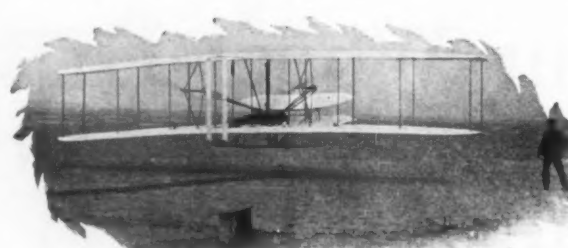
Our Navy's Way of Doing Things

On the 27th of July, 1917, Secretary of the Navy Daniels affixed his signature to a document, which authorized the construction of the only Government-owned aircraft factory this country has ever possessed. This date marks the birth of the Naval Aircraft Factory; 14 days later at the League Island Navy Yard, in Philadelphia, construction work itself actually began. It was truly a pioneer undertaking and like all such undertakings, the very breadth of its possibilities was measured also by the difficulties attendant upon its construction.

There were urgent reasons for the establishment of such an enterprise. The increasing menace of the submarine, and consequent demand for seaplanes, the development of new models, the improvement of those already available, and the necessity of obtaining information with regard to the actual cost of production, all combined to make the Naval Aircraft Factory an immediate necessity. One of its slogans from the very beginning was speed, more speed, and still more speed. From the day the first spade struck earth the work proceeded with an incredible swiftness. On the 16th of October the first machinery started in motion; three weeks later the keel for the first boat seaplane was laid, and in March, 1918, the first service machine produced by the factory successfully accomplished its initial flight.

The original manufacturing unit with a ground area of 160,000 square feet is a permanent steel structure of the most durable type. It was built and equipped in about three months' time at a cost of a million dollars; and the mechanics followed so closely on the heels of the builder that the entire plant was in operation before the building was completed.

Early in January, 1918, the Navy's aircraft program was very largely expanded, carrying it far beyond the manufacturing facilities hitherto assigned to the Navy. Quite naturally this brought about an enlargement of the factory, comprising five buildings with a floor area five times that of the original plant. The augmented program required new aircraft faster than they could be provided by building an entirely balanced factory. The authorities therefore contemplated that the new extension should be an assembly plant and in proportion to its growth, privately-owned manufacturing facilities be taken off their regular commercial work and placed under contract to furnish the hulls, wings and other parts needed. Thus branches of this establishment appeared in many places through the East and turned their activities to a common end under the direction of the Naval Aircraft Factory's staff of engineers.



THE AIRPLANE is fifteen years old this month. For it was back in December, 1903, that the Wright brothers equipped a biplane glider with a gasoline engine and made a flight of 59 seconds, in secret, as was their modest way. Later they made flights in public, convincing a skeptical world of their conquest of the air. In that brief span of fifteen years the airplane has developed from the crude craft illustrated above, which was at the mercy of the slightest summer breezes, to the 150-mile-an-hour scouts and the huge 50-passenger planes of today, which can weather any wind short of a gale. And as a crowning achievement the United States, the home of the Wrights, has at last taken its place with the other great powers at the forefront of aviation. We have established a great aeronautical industry to care for our needs in war and in peace, as well as our first Government-owned aircraft factory for supplying the needs of our Navy.—THE EDITOR.

The new plant was designed with generous dimensions for the accommodation of such larger sizes of planes as the future might develop; and the plant itself was laid out for manufacture on modern lines, presenting particularly the feature of progressive assembly.

A glimpse of the buildings which now extend over 40 acres of ground along the Delaware offers visual proof of the completeness with which the whole undertaking was accomplished. One broadside view of the assembly plant gives the onlooker the impression of a huge reflector; with its thousands of square feet of almost solid glass, the effect is truly striking. Within the building, the impression is intensified; the long busy place is literally bathed in sunlight and humming with activity. On one side is seen a tremendous hull, swung overhead by a traveling crane; on another, completed wing panels assembled for inspection, each set spreading over a hundred feet in length; ahead is a department where women in overalls are contributing their share of work to the finished whole. Beyond a train pulls out of the factory with planes packed for shipment overseas. In truth, the manufacturing unit of this aircraft factory is several industries in one. There is a large woodworking division, a complete metal shop, and a boatbuilding plant, each with numerous subdivisions. And then there is the huge assembling division which assembles parts supplied by outside plants, as already mentioned.

The Matter of Personnel

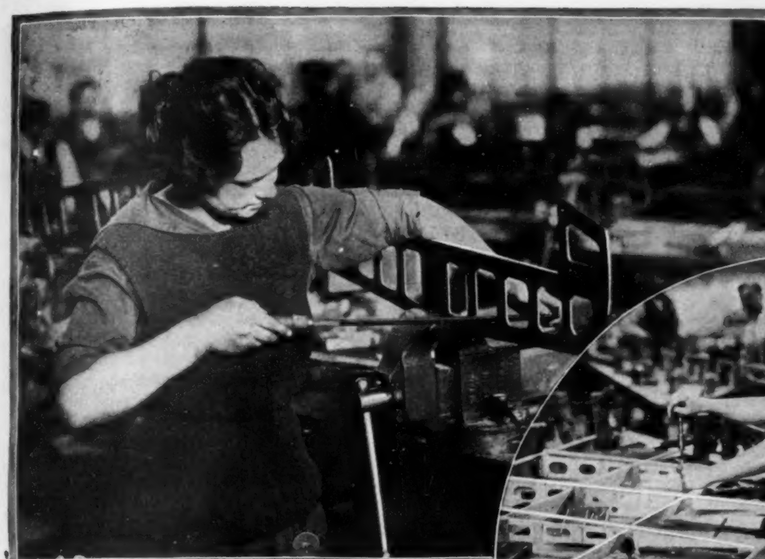
When a manager was selected the site of the Naval Aircraft Factory was a level bit of pasture. Few men have been assigned a task that loomed so large from the very beginning. In this instance the expression, "Built from the ground up," applied to the very letter. To Naval Constructor F. G. Coburn was assigned the management of the enterprise, and because of his wide experience as a naval architect and marine engineer, as well as considerable industrial experience, it would be difficult indeed to find a man better qualified for the post.

Obviously, the first step was the securing of an executive force as a nucleus, and as the officers of the regular Navy were needed elsewhere, the manager went about selecting from civil life men peculiarly adapted to

The huge boat shop where the 50-foot hulls of our Naval seaplanes are progressively built

Assembly plant, where the numerous finished components come together in the complete seaplane

Bird's-eye views of two departments of the Naval Aircraft Factory at the League Island Navy Yard, Philadelphia



the needs of such an undertaking. It is interesting to note that no two of the principal department heads came from the same line of industry.

Upon the Employment Department fell the problem of supplying man-power. It used all usual methods including those provided by the Government. This was but a starting place as they not only recruited talent but discovered and developed it. The employment department system relieves the factory supervisors of much routine and detail, and permits their energies to be focused on production; it precludes the possibility of so-called "shop favoritism" in promotion and assignments; the worker may be measured by a broader standard and by transfer if necessary his proper niche may be found; also by close contact he is given advice and counsel for his personal benefit. An open door is maintained for the submitting of suggestions and complaints.

A feature of the process of developing personnel is the apprenticeship school for women. From all walks of life have come women with no previous training and actuated only by patriotism and the needs of the times. Most of their work from the start is on the actual product, thus no time, labor or interest is lost. They are carefully instructed in factory methods and rules. The effectiveness of the means used in adding women to the factory's personnel may well be expressed in figures, since nearly 1,000 of the 3,600 employees are women and their work is a factor in practically every department.

Like all sagacious employers of today, the Naval Aircraft Factory takes good care of its workers. Light, air, heat, pleasant surroundings—all these factors enter into keeping the personnel at the highest pitch of enthusiasm and efficiency. A cafeteria, far above the average, is operated within the factory and three meals a day are here obtainable. During the noonday luncheon period a Naval band furnishes relaxation.

Special Departments Which "Carry On"

The Engineering Department of the factory covers the designing of experimental and production machines, the inspection and testing of material, work in progress and the completed product; also there is a trial section for the testing of finished seaplanes under the direction of skilled pilots. Another important feature in this department is the drawing up of specifications for materials including the work and application of them.

A department known as the Manufacturing Office receives the requirements of the Navy Department and accumulates all necessary data for the requisitioning of materials, issuance of orders to all factory departments and the scheduling of work and equipment. The clerical work of production is concentrated here to leave the executives of the manufacturing departments free for the closer supervision of actual production.

The Supply Department has used every means of rapid transportation for the earliest possible delivery of parts. Sometimes parts have come in carloads by express; again, they have been brought in as baggage in suit cases and trunks, so urgent has been the need for seaplanes in the past. The Contract Manufacturing Department has the responsibility of keeping the large assembly plant going to capacity by supplying the component parts of the finished product for final assembly.

For the manufacture of hulls the yards of many former yacht builders have been utilized; for wing panels several large woodworking establishments; for metal parts, still other factories. At all these places branch offices have been established for directing the production, for inspection, and for technical instruction. Employed on the work done by these contractors are about 6,000 persons and 25 acres of floor space, which must rightfully be added to that of the Naval Aircraft Factory proper.

The Product of the Naval Aircraft Factory

And now we come to the product of the Naval Aircraft Factory, which at present and for some time past has been a giant seaplane or flying boat, designed for the campaign against the German U-boats in European waters.

At first glance, the giant seaplane of our Navy appears formidable while resting on the water, and still more so when hauled up on shore where its boat-like body lies fully uncovered to view. In flight it does not seem so large; indeed, it might well be mistaken for the smaller flying boats by the layman, since all aircraft are deceptive while in flight. But viewed close up there can be no mistake about the size of this craft, with its 110-foot span, two Liberty motors developing from 400 to 500 horse-power each and driving propellers 10½ feet in diameter, and a body over 50 feet in length. The fact is that the body, or hull, is nothing short of a 50-foot yacht, but instead of velvet-cushioned berths and other comforts its interior is given over to a tangle of braces, wires, steering and controling devices, instruments, a wireless station, a six-station intercommunicating telephone system, fuel tanks and guns, all of which are the means of combating the U-boat and of carrying out long-distance patrols at sea. On the water the seaplane develops a speed up to 50 miles an hour, and the moment it slips off the surface and soars upwards the speed increases to 100 miles an hour.

As in every other heavier-than-air machine, the naval aircraft engineers have had to secure strength in their structure while keeping a strict eye on the weight. Thus the required strength of every piece

(*Continued on page 486*)

In these views appear women workers doing delicate and difficult work on the Naval aircraft, ranging from the welding and filing of metal fittings to the assembling of the huge wings.

Representatives of the army of women aircraft workers

At the left: Seaplane hull, which is practically a 50-foot motor boat, in process of construction. *Above:* The keel and wooden ribs of a seaplane hull, early in the building process. *At the right:* One of the three crates in which each seaplane is shipped overseas; in this case the crate contains the hull.

A pictorial story of the seaplane hull from the laying of the keel to its crating for overseas shipment

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

The Small Threshing Rig

THE common use of the small, lightweight tractor has emphasized the demand for small grain thrashers. In many communities it has become increasingly difficult to secure custom threshing rigs at the proper time. This condition has been aggravated by the scarcity of labor and by the high cost of machinery. At the same time, the farmer becomes more restless than he formerly did when threshing delays were occasioned from one cause or another, for, whereas only 80-cent wheat was involved, now it is a $2 product and he can ill afford to have even one bushel wasted.

Another factor enters here. With the increase in price of all kinds of farm machinery, the investment in equipment which may be considered necessary even on a moderate sized farm is greater than the farm can carry. There comes a desire, then, on the part of many farmers, to buy the larger and more expensive equipment in partnership. The success of such a venture depends, of course, upon the team-work capacity of the neighbors involved. The scheme has worked, and worked successfully, too, in many instances that have come under the writer's observation.

The tractor has increased the possibilities in this direction. A group of four farmers, one of whom may own a tractor, may well consider the purchase of such machines as a husker and shredder, an ensilage cutter, a hay baler, a large grinder, and a small thresher. The team and labor forces from even four average farms could operate any of the machines mentioned, in a very satisfactory manner. This makes the farmers of a community independent as regards the custom thresher and enables them to grapple more successfully with the acute labor shortage now existing the world over.

Tractor of Good Design and Construction

PROPER lubrication and protection from dust are two highly important features which the tractor designer must keep constantly in mind. The tractor must work in the dust and heat of August as well as in the slush and snow of winter. Many operators become careless in their attention to the lubrication system, consequently the more nearly foolproof the machine can be made in this respect the better. Dust and mud are very destructive to bearings.

The tractor shown on this page, drawing a wagon and hay loader, a closer view of which is shown in the tractor drawing the plows, is particularly well fortified in these two particulars. All of the gears are completely enclosed and the most of them either run in oil or are lubricated by an efficient force-feed oiler.

Note also the compact arrangement of the power unit and transmission system. Here is a four-cylinder valve-in-head motor, bore 4¼x5¾, with a normal speed of 850 to 900 r.p.m. The tractor is rated at 13⅓ to 17⅓ drawbar horse-power and 25 horse-power at the belt. The weight of the entire machine is 3,000 pounds and it has a turning radius of 10 feet.

While this tractor is not the lowest priced machine on the market, that statement would not imply that it is the most expensive. The cost of a machine is what one puts into it; the value, what one gets out of it. The value of a tractor depends upon the efficiency with which it operates and the length of time it remains in service. Therefore, the machine that costs the most may be the most economical in the end—a point to keep constantly in mind when buying machinery of any kind.

The Combined Thresher and Header

WHERE a considerable acreage of grain is grown and where fields are large, combined headers and threshers are used. These are large, powerful machines drawn by twenty to thirty mules or by tractors. In a single operation the grain is cut, threshed, sacked and dropped from the machine in piles where, in certain regions, it may lay for months before going to market.

In regions of less extensive farming, headers alone are used. As might be anticipated, the machine is pushed ahead of the tractor, the most common source of power for this and similar machines. A swath some 20 feet wide is covered. The object being to handle as little straw as possible, the grain is cut but a short distance below the lowest heads. The cut portion of the grain is carried to the elevator by means of which it is dumped into a wagon drawn alongside the header. It is then taken to a stationary thresher, threshed and sacked.

The use of such labor saving machinery has so far reduced the time and labor necessary to produce a bushel of wheat as to require about ten minutes where formerly over three hours were required.

A tractor that is well protected against damage to its working parts

Operating the Hay-Loader with a Tractor

THE uses to which a tractor on the farm can be put are legion. The accompanying photograph shows a very desirable and unique tractor performing a task to which it is well adapted. To draw a wagon and hay loader easily requires three or four horses. The team requires a driver, and a boy can drive a tractor even better than a team since it is much easier to control the speed of the tractor than of the team. It is very much to the advantage of the men on the load to have the outfit drawn steadily, otherwise they are jostled about and must give much of their time and attention to maintaining their balance. It requries two men, by the way, to load after a loader in an easy and satisfactory manner. Perhaps we should not say easy, for there is no such thing as easy work in front of a loader.

The hay loader is a wonderful time and labor saver. There are but few farms on which it cannot find a profitable place. The average farm hand will consume one hour of time in pitching on a load of hay from the windrow, with one man on the wagon. The same two men can, with the use of a loader, put on a load in fifteen to twenty minutes. This leaves them at least 40 minutes in which to haul the load to the barn and put it in the mow. The writer in connection with one farm hand could for several days in succession average one load per hour from field to mow, taking the hay from the windrow. For a long haul from field to barn the total time per load would of course be materially increased.

By-Products on the Farm

THE packers claim to make all their profits out of the by-products, sources of income which were utterly ignored not many years ago. A good many farmers may be skeptical of this claim in its entirety, but no one doubts that the packers turn by-products to good account. It is interesting to note the great progress farmers have made in a similar direction.

Not many years ago straw stacks were counted valueless, and everywhere burned. Now progressive farmers spread the straw and find it a valuable fertilizer, and while burning is still much too often practiced it is a dying custom. In some sections of western Canada the government has this year forbidden the burning of straw stacks.

Corn stover has a fluctuating value from year to year, varying with the supply of other roughages and livestock conditions, but its feeding value is definitely known, and for some years past the tendency has been toward wider use of the stalks.

Cottonseed, valuable both as a feed and a fertilizer, was formerly thrown away. It is now a by-product of tremendous importance, not alone to the cotton industry, but to innumerable cattle feeders.

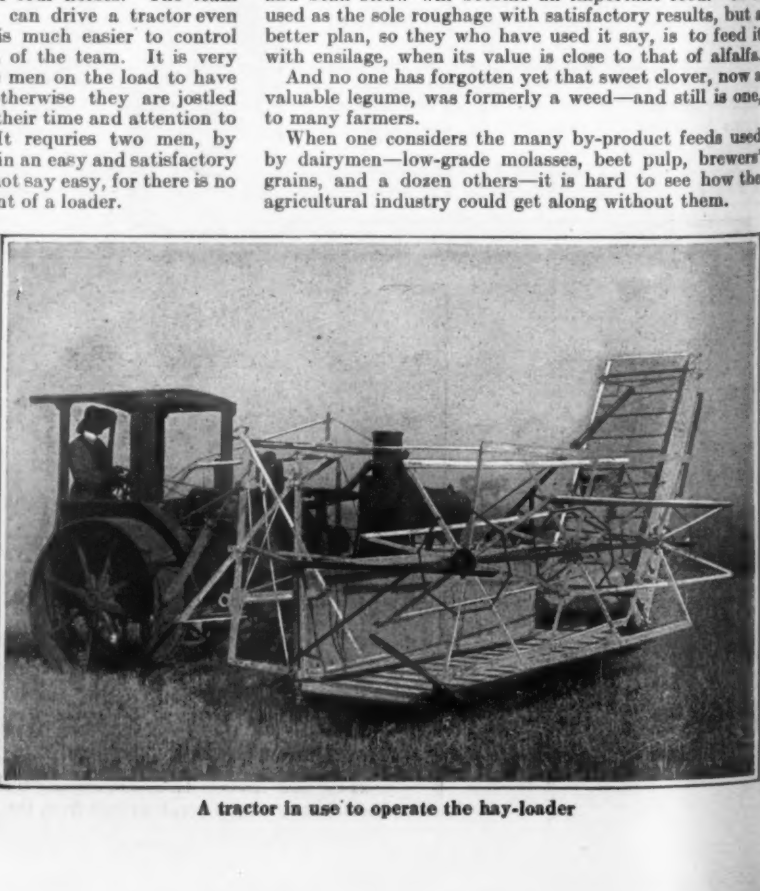
Far West cattle feeders would find it difficult to dispense with ensiled beet-tops, nutritious by-product of beet growing for the sugar factories.

Hardly a year passes that some waste product is not utilized in a large way for the first time. One of the newest high-protein chicken feeds is the rinds and waste cuttings of Wisconsin cheese pressed into large bricks. It is now being marketed on a commercial scale. Cattle and sheep feeders in the pinto-bean territory, which now takes in practically all of New Mexico and Colorado, and growing areas in Wyoming, Nebraska and Kansas, are fast making bean straw a standard article. Bean growing in this section is undergoing great development, and bean straw will become an important feed. It is used as the sole roughage with satisfactory results, but a better plan, so they who have used it say, is to feed it with ensilage, when its value is close to that of alfalfa.

And no one has forgotten yet that sweet clover, now a valuable legume, was formerly a weed—and still is one, to many farmers.

When one considers the many by-product feeds used by dairymen—low-grade molasses, beet pulp, brewers' grains, and a dozen others—it is hard to see how the agricultural industry could get along without them.

A closer view of the tractor that is proof against mud and dust



A tractor in use to operate the hay-loader

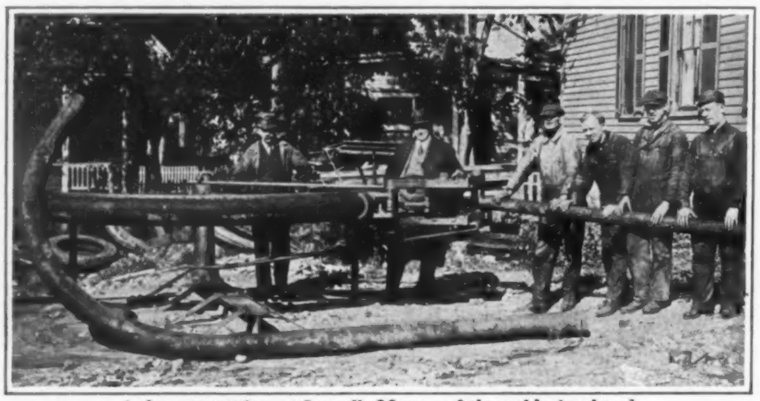
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Bending Pipe Cold

THE interesting picture presented herewith shows the operation of a new machine for bending pipe cold, with great saving of time and expense. The very suggestion that a six-inch pipe be bent, cold, to an angle of 90 degrees, seems a rather formidable one; but here we see it being done. Not only does the machine do it, but it does it in 10 minutes or less, at a cost, for labor, of about $1.50 for the six laborers who are needed at the l ver of the machine. This is contrasted with the several hours and the $25 cost of doing the work by more traditional methods.

The operating principles of the machine require little discussion; it simply bends the pipe, and that is all there is to it. It furnishes a lever and a fulcrum, and a sufficiently gentle application of the power to prevent the pipe under treatment from developing cracks.



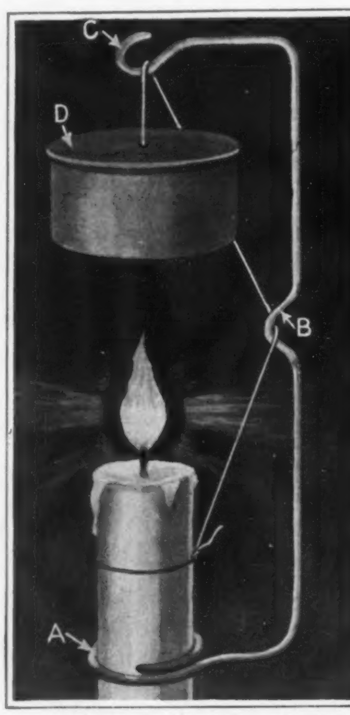
A demonstration at Lowell, Mass., of the cold pipe bend

An Automatic Candle Extinguisher

A NOVEL candle extinguisher that operates within a given time is shown in the sketch. It is a scheme that proved most useful in Europe during the war.

A support of stout wire is twisted round so that it will fit over the candle firmly as at *A*. A little more than half way up the wire is bent inward in a semicircle *B*. Then at the top the wire curves over and ends in a loop as at *C*. The bottom half of a can is cut to act as an extinguisher *D*. A piece of thin twine is pushed through a hole right at the center of the bottom of the can. This is then threaded through the loop in the wire, passed over the curved part, and finally tied round the candle in the manner shown.

Some idea of the rate at which the candle burns is obtained by observation. As a matter of fact a candle of ordinary size will burn about half an inch in an hour. It is easy to find out the actual rate of consumption in any make of candle. Suppose that it is desired to have the candle extinguished in one hour, and the candle burns down half an inch in this period. It is only necessary to tie the twine round half an inch below the top of the candle. The extinguishing of the candle takes place when the light has burned away the wax to this point. Then the twine is released and, of course, down comes the extinguisher.



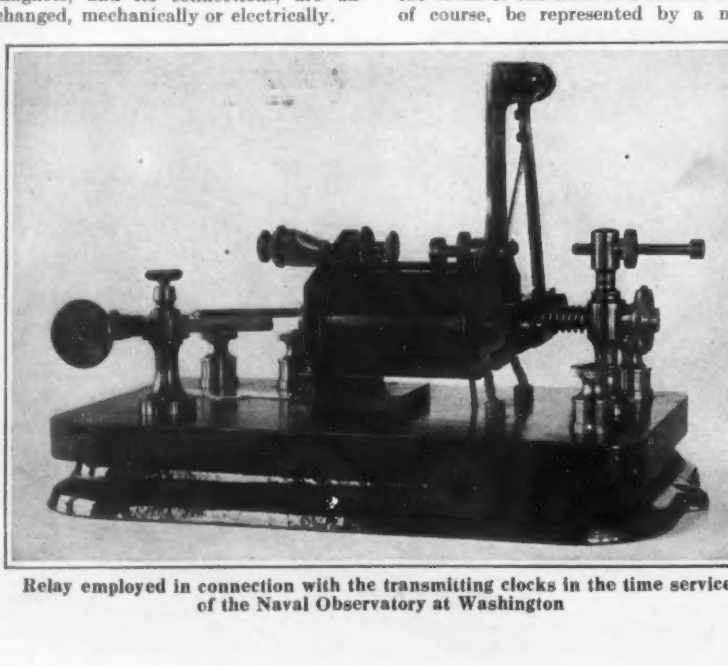
A war-time invention—the automatic candle-extinguisher

A New Clock Relay for Telegraphic Transmission of Time Signals

A NOVEL attachment for a relay has been in use for several months in connection with the transmitting clocks in the time service of the Naval Observatory. The time signals, which consist of a series of "makes," each of which is about one-third of a second long, originate as very short breaks in a local circuit passing through a transmitting clock. These breaks are somewhat less than one-tenth of a second in length. They are transformed into makes by reversing the contact points of certain relays operated by the clock. It is desirable to have both the telegraphic and the radio signals longer than one-tenth of a second, in order to improve the transmission of the former to great distances, and to make the latter more easily heard when they are weak. This was formerly accomplished by lengthening the travel of the armature of the clock relay and increasing the tension of the spring which actuated it, until the magnets were barely able to move the armature against the spring—a method which occasionally resulted in the armature sticking and interrupting the signals.

The relay shown in the photograph is provided with a device which lengthens the clock breaks the desired amount without the necessity of putting the relay out of adjustment. The soft iron bar which joined the poles of the electromagnets, making a horseshoe magnet of them, was removed, and a brass plate substituted, which holds the magnets in the proper position without interfering with the the lines of force. The two additional poles thus made available are used to control another armature. This armature is in the form of a pendulum, about three inches in length, and it is supported by the brass plate mentioned above. A larger hole was drilled through the middle of the armature to permit the passage of the screw and spiral spring with which the magnets are adjusted. The pendulum carries, on the side next to the magnets, a slender, flat, brass spring. The upper end of the spring is attached to the pendulum just below the pivots, and the lower end, which is free, is tipped with a small piece of platinum. When the pendulum is at rest, its armature is separated from the cores of the magnets by about one-eighth of an inch, and the platinum tip of the spring is in contact with the end of a horizontal screw which is inserted through a hole in the brass plate. This screw is insulated from the plate and is connected with one of the terminals of the coils. The binding post which was formerly at this terminal is now connected with the plate carrying the pendulum, and hence with the contact spring. The regular armature at the other end of the magnets, and its connections, are unchanged, mechanically or electrically.

The coils and a battery are in the circuit controlled by the transmitting clock; when this circuit is closed, both armatures move up to the magnets, the pendulum bending the spring which it carries in doing so. In sending a signal, the clock breaks the circuit, and the regular armature moves away from the magnets, opening the secondary circuit. The pendulum armature swings away from the magnets at the same time, impelled partly by gravity and partly by the spring contact. Its momentum carries it well beyond its normal position, and the spring goes with it, opening the clock circuit at the spring contact also. About one-tenth of a second after the clock opens the circuit, it is closed again at the clock, but without effect, since the circuit is still held open at the spring contact, by the pendulum. The latter having lost its momentum swings back under the influence of gravity, closes the circuit again, and then feeling the attraction of the magnets, continues the rest of the way under their influence. The regular armature returns to the magnets also, and closes the secondary circuit one-third of a second after opening it. If the contacts were reversed, the break of one-third of a second would, of course, be represented by a make.



Relay employed in connection with the transmitting clocks in the time service of the Naval Observatory at Washington

In the time service, the clock relay operates a series of 10 other relays, and the reversed points are on these.

The preliminary signals, made as described above, are sent for each second except those omitted for identification. The final signal, which marks the beginning of a new hour, lasts about 1.1 seconds, and its duration is determined by the clock itself instead of by the relay. It is worthy of notice that the beginning of each signal is determined by the clock, the pendulum armature doing nothing more than retarding its conclusion, which is as it should be. If the pendulum armature is held against the magnets, the other armature will duplicate the short breaks made by the clock. The relay has a resistance of 100 ohms and requires a current of 60 milli-amperes to operate it.

The idea of using a pendulum for this purpose was suggested by a similar device used several years ago with the printing chronograph of the nine-inch transit circle at this observatory, by Dr. H. R. Morgan and Mr. J. B. Eppes, in which a pendulum was substituted for the armature of a relay. The pendulum did not control the clock circuit, but, having a rather large amplitude, swung practically out of reach of the influence of the magnets during the short interval that the clock held its circuit open.

In this connection it may be of interest to describe a simple method for shortening clock breaks which are already too long. This is seldom necessary except with occasional break-circuit chronometers, which, either from being out of adjustment or with the intention of the maker, break the circuit with one motion of the escapement and close it with the next. Such a chronometer gives half-second breaks, which are too long to be used satisfactorily on an ordinary chronograph. The breaks can be shortened by placing two relays in the chronometer circuit with their coils in series, and with their contact points in parallel in the chronograph circuit. The points of one relay should be reversed and its armature should have a longer travel than that of the other relay. The tension on the spring of the relay with the reversed points should then be increased until the chronograph circuit is not interrupted at the conclusion of the half-second breaks. The adjustment is easy if this armature is rather heavy; if it is very light, it may be necessary to weight it. The resulting breaks will be nearly as short as the chronograph can record; the extra relay merely cuts off the conclusion of each break and does not affect the accuracy of its beginning.

Notes for Inventors

A Wrist Blotter.—In these days of wrist watches there seems to be a call for the simple wrist blotter recently invented by Harland W. Cardwell of Texarkana, Tex. This device consists merely of a curved blotter back, blotter, and a wrist strap, so that the blotter may be worn on the right hand of the user. Thus the blotter is instantly available for use, and the pen does not have to be laid down.—

Combination Comb and Brush is the contribution of Clarence M. Deason of Carnegie, Okla., to the numerous ingenious inventions of recent date. His device consists merely of a modified form of hair brush in which is incorporated a comb in such a manner that it can be projected beyond the bristles of the brush or retracted into an arched cover plate, according to whether it is to be used or not. The movement of the comb is of the simplest, and in every way the device should meet with favor because of its convenience.

Peace and Inventions.—With the termination of hostilities the inventor again comes into his own. While it is true that the war has given certain opportunities to those inventors of a military turn of mind, as a whole it has had a deterrent effect on invention. Numerous inventors with excellent ideas

(*Continued on page 487*)

Reconstruction

MANUFACTURERS who have built up organizations for the production of war material must choose between disbanding their employees and dismantling their plants, or taking up some new line of manufacture adapted to the machinery with which they are equipped. Obviously, the latter is the better choice, provided a suitable article of manufacture can be found. We have received a number of letters asking us to suggest new lines of manufacture and requesting information regarding promising inventions. We believe it a real service to our country to give such letters wide publicity and to ask our readers to help us answer them. Replies to these appeals should be addressed to the Reconstruction Editor, who will pass them on to the writers of the letters.

To the Editor of the SCIENTIFIC AMERICAN:

We wish to make an unusual request and although it is being made in much the same sense to a number of publications, we trust that you will give it your usual earnest consideration.

A large manufacturer of metal goods who has expanded his plant's facilities enormously to meet the requirements of the Government, will soon be in a position to manufacture some articles of commercial use which will employ the increased facilities. He has employed us to make an investigation of products which have or will have a very wide market and will justify advertising in an extensive scale. We are conducting a search for the best article to manufacture.

We would like to have you make copies of this letter for editors and others of your organization, and see if some of them haven't a suggestion to offer. The following information may be of service to them in considering the matter.

The plant includes a foundry, machine shop, heat treating and sheet metal work, and a finishing department. They have men competent to make electric motors and develop products on sound engineering and scientific lines.

The manufacturer is open to suggestions for a product which is new or comparatively new, provided it seems to have a very large market so that standardizations through the plant will result in greatest economy of production. They are not disposed to consider anything which is so high in price and so limited in market that it will not use a good proportion of the plant's facilities. They figure on production of a million to a million and a half dollars a year at factory cost. That is, the market has to promise a sale of ten to fifteen thousand articles at a hundred dollars each, or two or three hundred thousand at five dollars each.

Somewhere in your organization there is a man who knows, or thinks he knows, what *he* would make if he had such a factory and ample resources and he can explain why the proposition looks promising to him.

If any member of your staff thinks his ideas are well enough matured to be worth something to the manufacturer, and wishes to communicate with us before outlining his ideas, we will be glad to take the matter up with our client. However, we cannot afford to tie up the whole program of search with negotiations of that character.

An automobile motor company writes as follows:

To the Editor of the SCIENTIFIC AMERICAN:

We will very shortly have, through the termination of war contracts, a great surplus of well trained labor, both male and female, which we would like to keep employed. On this account, we would be much interested in the manufacture of any small article of merit that your clients may produce. We would be glad to have you put them in touch with us, if it is proper to suggest this to you.

These articles could be manufactured by the undersigned organization or under another name, but the same personnel.

The Current Supplement

ALL of the leading countries of the world are feverishly active in building ships for mercantile purposes, and within a year great fleets of vessels will be busily engaged in a distribution of products and manufactures to equalize the demands that have resulted from the war. These fleets will undoubtedly considerably exceed both in number and tonnage those in existence before the war and the manning of these numerous ships is proving quite a problem, especially for America, where the native seaman have largely disappeared, and this is particularly the case in regard to officers to operate and navigate our new fleet. To meet this demand numerous schools of navigation have been established where the fundamentals are being taught to a large number of young men, and with the revival of the science there will undoubtedly be an increased interest in its history. A review of this will be found in *The Rise of Navigation* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2241, for December 14th, which traces the slow steps by which it was evolved. One of the new arts developed by the war is aerial photography, or map making by the camera, which has become one of the most valuable and indispensible branches of the military service by furnishing prompt and accurate information of the doings of the enemy, and the locations of his armies and batteries. A general account of this work, accompanied by photographs, will be found in *Map Making from the Sky*. *The Movements of Oil and Gas Through Rocks* deals with a geological problem that has a practical bearing in these days of the internal combustion motor. *Typical Scenes in a Steel Plant* illustrates and describes some operations that are of importance in these busy times of reconstruction. There are a number of excellent photographs accompanying the article. *Liquid Crystals* deals with a particularly interesting branch of physics. *Sound Steel by Lateral Compression* describes experiments of considerable economic importance in the manufacture of steel. It is illustrated by diagrams. *Some Cotton Seed Products* considers the utilization of a material that, but a few years ago, was considered largely worthless. Other articles of interest in this issue are *Chemical Analysis by a Magnetic Process, The Smithsonian Solar Constant, Expedition to Calama, Peru, Salvage of Ships in Great Britain* and *The Dellwik Process for Completely Gasifying Coal.*

Spotting the Shots

(Continued from page 477)

within a second or so of the final signal. Where there are two or more observers from different angles, no other method can serve, because it is vital that all observe the same shot, otherwise the resulting calculations are much worse than none at all.

So intimately interwoven are the various manufacturing processes of ammunition, the various calculations for laying and aiming a gun, and the intricacies of observation, that a failure anywhere along the line may mean failure of the shot. Even the fuse has great influence upon observation, and the character of the soil fired upon will have another equally great effect. Fuses are known as instantaneous, delayed-action or non-delayed. The instantaneous fuse shell, striking hard ground, bursts on the surface, with a broad and rather low burst. This makes the best possible sight for the aerial observer, who sees things well as they are spread out, ill, as they are tall and slender. A slight delayed-action fuse against hard ground, usually results in the shell bursting underground, which makes a tall slender burst; the same thing results from an instantaneous fuse shell fired at very soft ground. With a long delay-action fuse the shell bursts so deeply underground that nothing results at first which can be seen from high in air—then the smoke issues gradually from the earth. Such fuses are unfavorable for observation purposes.

Hence it is that when destructive fire is being used—fire to eliminate dug-outs or to wreck a road, as distinguished from fire which is to eliminate personel (for which of course a surface burst is wanted),—the adjustment of fire is first effected with non-delay or instantaneous fuses, and every fifth or sixth shot is also with a similar fuse, in order that the aerial observer may have something he can easily see, and thus be enabled to maintain the adjustment.

Ideal conditions seldom obtain on the battlefield. A bright, cloudless day, an unobstructed terrain, a quiet sector, are all desirable for long-range gunnery and airplane observation, but battles nor armies wait on weather, and sectors have a habit of being most active when the big guns are active. Hence it follows that it isn't always possible to observe the target from a plane continuously. A cloud may obscure the target with a shadow at the wrong instant, and the observer, especially if very high and not close over the target,

may fail to see the burst. Terrestrial observation is often obscured by smoke, especially if there is barrage fire.

In such cases the battery depends on the observer's signal, and fires, not within thirty seconds of his signal, but instantly on getting it. To fail to do so may be to land the shot at a moment when it cannot be seen, and, as far as adjustment of fire is concerned at long ranges, an unseen shot is a shot wasted.

A peculiar human element comes into play with observers which has to be guarded against, very much as the personal equation of an astronomical observer must be checked up and eliminated in the interest of accuracy. Observers are very prone to report "hit" when the shot is close to but not on the target. It is not a case of the baseball fan who sees the home base runner "safe" when he is actually "out" from a partisan desire to win, but a mental condition. Observers, especially inexperienced ones, sometimes deduce things from what they see and send reports of their deductions. The expert observer reports what he has seen and only what he has seen. Strangely enough, the observer's work is one requiring a high degree of moral courage. For observers make mistakes; and they can make no worse one than failing to report their mistakes as they discover them. An observer who has been carefully and conscientiously directing fire from a distant battery on one neck of woods only to discover that the right spot is half a mile away must have moral courage enough to say so instantly—it is a matter of degree and not kind that he also report any observation as "doubtful" if he is not absolutely certain of what he has seen and its interpretation.

It should not be understood that the elevation of the gun is changed for every "over" or "short" burst reported by observation, or that the gun is repointed to right or left with every report of a burst to either side of the target. For the single shot no process or mathematics will invariably secure a hit, because of the variable factors in gunnery beyond human control, such as dampness in the atmosphere, variation in powder due to chemical change, alterations in the gun due to use, failure properly to judge wind, incomplete meteorological data or failure of the air conditions to equal the calculations made for them, etc. But for a sufficient number of shots (depending on the size of the target, the skill of the gunners and the accuracy of the observations), the destruction of the target is a mathematical certainty.

Every big gun has a "zone of dispersion" in which a shot fired at a given target should fall. This zone is long and narrow (since the factors which produce variations in range do so to a greater extent than those which work for variation in direction). The fire of several guns from a battery has a "center of impact." If all the zones of dispersion are adjusted so that their centers are upon the target, the center of impact of the various salvos can also be laid on the target, and it is then only a matter of time until a sufficient number of shells make hits and demolish the thing aimed at.

Naturally, when firing at great ranges, over hills, at something the gunner cannot see, or can observe but faintly and with difficulty, the accuracy of the controling observation is the factor of highest importance in big gunnery. All due credit to the battery commander who directs, the officers in charge of the guns, the men who man them and serve them. But in giving this credit, reserve one round of applause for the man aloft in a plane or suspended helpless from a balloon, fighting with his eyes and a telephone, or the lone observer lashed to tree tops or tied to a telegraph wire or in a church steeple. On their clear sight, good judgment and arduous training, depended the accuracy of the fire of the big guns which taught the Hun that America had something more to offer the God of Battles than a host of men.

Our Navy's Winged Destroyers

(Continued from page 481)

of material entering into the construction is determined by exhaustive test; and in a hundred ways both wood and metal parts are thinned and lightened until this maximum of strength is preserved and the minimum weight reached.

A completed wing painted its battleship gray looks like a solid steel armor plate; but strip off the fabric which carries the paint and inside is seen a skeleton frame of spruce webs and piano wire braces. The webs, or ribs, which form this frame are set between full length beams, these beams being reduced to the smallest possible

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size consistent with the great strain to which they are subjected. The webs, but ¼-inch thick, are but little more than their name implies, sections being cut from the center and ends of each, leaving only a frame suggestive of thin slices of Swiss cheese. At intervals across the uncut portion of the webs are secured small battens, which are less than 1/16-inch in thickness. Diagonal braces of piano wire, the tension of which is adjusted by turnbuckles, are stretched between the beams. Every part is carefully varnished as if for display and the whole covered by fabric stretched until it rings like a drum. The strength is there, to be sure, but the weight is not; so that a 40-foot wing, eight feet in width, which appears to weigh at least a ton, is readily lifted by one man.

This same construction is followed in the entire seaplane. The keel is but little more than a strip of wood, but a perfect system of bracing makes it strong as a steel girder. Multiple-ply veneer measuring less than 3/16-inch in thickness is used for planking and hull side covering. Brace wires and light tubular steel struts reinforce the entire structure. Every point not subjected to a direct strain is covered with fabric. Perfect materials and workmanship make the hull a canoe in weight and a torpedo boat destroyer in size and strength.

There is no haphazard work about the building of one of these boats. Every piece of wood or metal is given an individual part number. Each one is designed for a particular place and the use of jigs and dies makes possible a degree of standardization of wood and metal parts which is as near perfect as can be reached in aircraft production.

The building of the boats is carried on in a series of progressive operations, each group of workmen having its particular part of the work to perform. Each man becomes an expert at his task and speed as well as excellence is attained.

Applying the Lesson of the Automobile Manufacturer

Starting at the end of the huge shipbuilding hall, a hull is built from the laying of the main members of the skeleton or frame to the completed flying boat. By having a sufficient number of the frames in the different stages of construction, it is possible to send a completed hull out the door at the opposite end of the shop every day. The frames are built upside down up to a certain point, when they are turned right side up and the work continues to the finished hull. The frames are covered with thin veneer, marine glue, fabric and paint in forming the body of the huge seaplanes. While the hulls are being turned out the accompanying wings, tails, cable and other equipment are being produced in like manner so that they can all come together in the assembling plant.

Throughout, the progressive manufacturing methods are applied. It is possible to trace the progress of any given member of the seaplane from the crude to the finished product in the many departments of the great factory. Quantity production methods have been applied wherever feasible, but it is evident to the visitor that aircraft production calls for a vast amount of hand labor that cannot be replaced by machinery.

Six thousand separate and distinct pieces of wood are used in each seaplane. To hold these in place requires 50,000 wood screws and 46,000 nails, braces and tacks. Of veneer over 600 square feet is used, as well as 4,500 square feet of cotton fabric of unusual strength which takes the place of the expensive Irish linen formerly associated with airplanes. The 250 pieces of tubing aggregate 1,000 feet in length. To adjust the tension of the 5,000 feet of wire and cable over 500 turnbuckles are required. About 1,500 each of bolts, nuts and washers are needed to hold in place the 1,000 metal strips and fittings which are used in the seaplane. And every piece, which in any respect varies in size or shape from another, has its part number.

Completed, as depicted in the headpiece illustration, one of the Navy seaplanes weighs with its crew of five men about 14,000 pounds. It is generally equipped with one Davis non-recoil cannon and four Lewis guns, and has a cruising radius with its two motors and 500 gallons of gasoline of ten hours sustained flight. Primarily its purpose is bombing, and four powerful depth bombs of 250 pounds each are suspended beneath its wings.

The work on the Navy seaplane does not stop with the final assembly. There still remains the large task of disassembling its parts and boxing the complete outfit for overseas shipment. This work of packing includes not only the wings, ailerons, stabilizers, rudder, motors and propellers, but the hull as well. Three crates hold the seaplane being shipped, the principal and largest one, of course, being the one containing the hull. Next in size is the box holding the main panels, engine panel (the short, central section immediately over the motors), ailerons, and all accompanying struts, staywires and control cables. The third and smallest crate contains the tail section, consisting of the vertical and horizontal stabilizers, elevators, rudder and the braces, stays and cables required for their installation. The packing is done by a department that does nothing else. Seventy-five men are kept busy packing the huge seaplanes.

Changes in the present seaplane are being constantly evolved by the Engineering Experimental Department of the Naval Aircraft Factory. Altogether, they have first built three types of boats necessitating some 12,000 separate drawings and almost as many tests of material. One type of boat was designed, developed and built in 117 days. Another type was built and launched on schedule time, 111 days.

All changes are originally placed in the hands of the Experimental Section to develop, design and place on a manufacturing basis. Even after the boat is completed, it is their problem further to perfect the separate parts. In the case of one design shipped to Europe, Admiral Simms, U. S. N., cabled 13 or 14 improvements. Seventy-five per cent of these had already been worked out by the Experimental Section and were then in production. The remaining were designed, built and installed within four days from receipt of the recommendations.

All in all, the Naval Aircraft Factory is a permanent institution to which we can turn both now and in the future for our Naval aircraft needs.

Notes for Inventors

(Continued from page 484)

have experienced difficulty in securing capital with which to carry on their work. So in the majority of instances the inventors have for the past four years been looking forward to the days of peace, when normal conditions would again obtain for them. Already there are many indications that inventors are taking up their work on a peace-time basis. They are bringing out their ideas which have been lying dormant for all these years. And the call for ideas on the part of numerous manufacturers who have been engaged in the war industries, has opened up a fruitful field to prolific inventors. Never before have there been so many opportunities for interesting manufacturers in new ideas.

Protecting the Ash Can.—Of all the household furnishings in common use the ash can, if it can be considered in that category, is subjected to the greatest wear and tear. Thrown about, dropped down whole flights of stairs, hammered against ash carts, it receives numerous dents which not only make it unsightly in short order, but materially reduce its life. So much for what happens to the conventional ash can. It has remained for Samuel Goldowitz of Port Chester, N. Y., to equip the usual ash can with a number of bowed strips each secured at one end to a band and at the other end passed through a loop in a second band. Thus the bowed strips serve to take up all shocks which might otherwise result in denting its sides.

Memorandum Clip for Telephones.—If simplicity is a good thing in all inventions, then Jesse D. Langdon of Waterville, Wash., has an excellent idea. He has patented a memorandum clip for telephones consisting of a single piece of spring metal which embodies spring arms for engaging the mouth piece of the transmitter, and a curved resilient clamping arm which presses against the face of the transmitter and which serves to hold papers, cards, and so on.

A Forward Handle for Files.—It has always seemed to many that the file should be a two-handled tool. There is little more excuse for placing a handle at one end than at the other, since the tool has to be held at both ends to do the best work. Working along this line of reasoning, Francis J. Schlegel of Detroit, Mich., has devised and patented a simple form of forward handle for files. His device consists of a simple T-shaped attachment which is slipped over the forward end of the file and held in place by a spring clip arrangement.


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That's the happy holiday hunch, all-right!

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¶ For, Prince Albert is the smoke-that-wins-the-smiles; the little old happy thought that picks the spikes out of the atmosphere around the tribute-table early in the A. M. and keeps the sunshine flowing into jimmy pipes and makin's cigarettes ever after!

¶ You can't buy anything he'll appreciate so much! Because, Prince Albert's quality, fragrance and flavor will meet every taste and satisfaction desire he ever expressed! And, make-a-memorandum here: Prince Albert can't bite or parch! That's because it is made by our exclusive patented process that *cuts out* bite and parch!

¶ Take this tip: You can send this Prince Albert holiday-handout to the boys training at home camps! Say, what would punch in greater Christmas happiness than this joy'us gift? Only, get busy early, and keep clear of the last minute rush on P. A. and on the mails!

¶ Prince Albert in pound crystal glass humidors (with sponge moistener tops that keep the tobacco in perfect condition) is the distinctive Christmas package, all fussed-in-festal-finery, and equipped with a make-merry tag! Then, there are the handsome pound and half-pound tin humidors, the tidy red tins, and, the toppy red bags—a size to fit every need!

¶ You put P. A. on his list and let him in on regular jimmy pipe and home rolled cigarette joy!

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